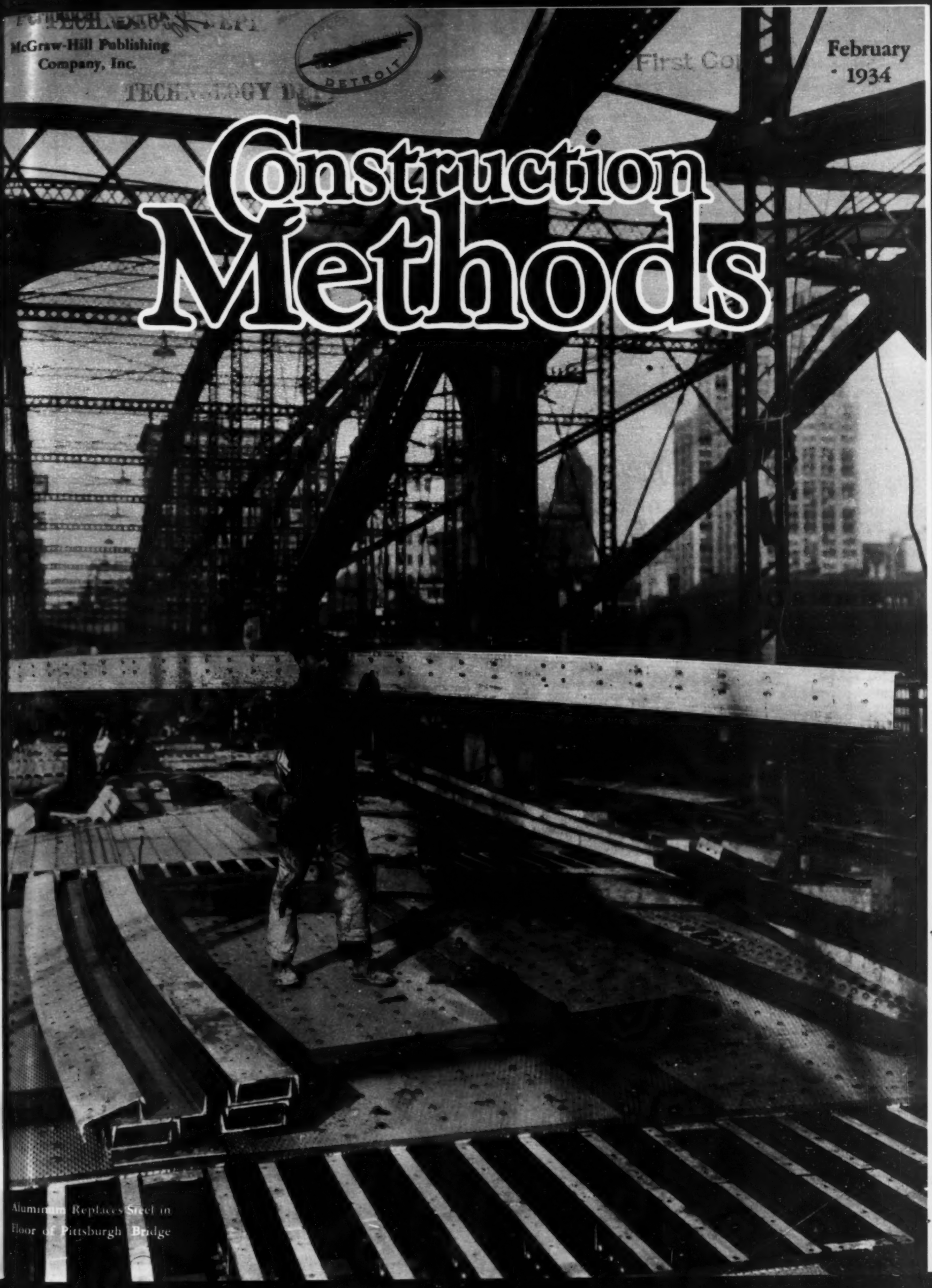
PETROIT
TECHNOLOGY

McGraw-Hill Publishing
Company, Inc.

February
1934

Construction Methods



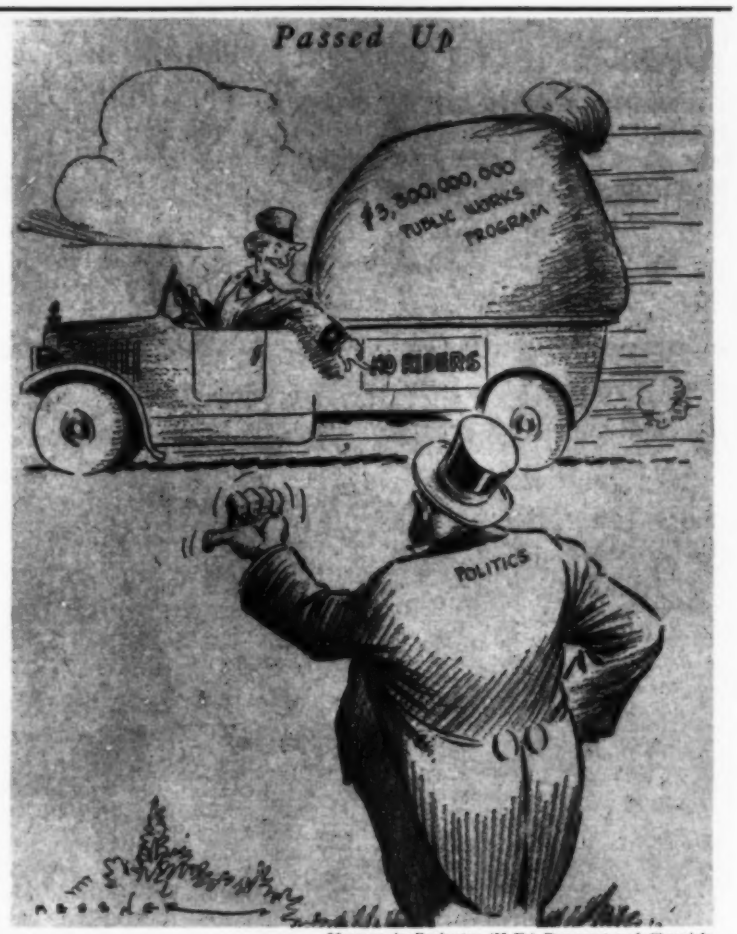
Aluminum Replaces Steel in Floor of Pittsburgh Bridge

Barber-Greene Company
MANUFACTURERS
MATERIAL HANDLING MACHINES
Aurora, Illinois
Mr. Contractor
Mr. Engineer
We have enjoyed the reputation of building "Standardized Material Handling Machines" of the highest quality.
But we render a service - less generally known. If necessary, we will DEVELOP the machine that answers your peculiar problems. From our thousands of standard parts and sub-assemblies, from our vast experience in the handling and processing of a tremendous variety of materials, and from the ingenuity that has manifest itself in every Barber-Greene product, we can build the answer to your problem.
Here we show many B-G products, mostly standard, some special, but all built around the maze of standardized parts and assemblies that form the basis of the Barber-Greene Plan.
Let us work together on your problems.
BARBER-GREENE COMPANY
BARBER GREENE

TECHNOLOGY DEPT.

Construction Methods

McGraw-Hill Publishing Company, Inc., 330 West 42nd St., New York
ROBERT K. TOMLIN, Editor
Editorial Staff: Vincent B. Smith, J. I. Ballard (San Francisco)
Leonard H. Church (Cleveland), Nelle Fitzgerald
WILLARD CHEVALIER, Publishing Director



Messner, in Rochester (N. Y.) Democrat and Chronicle

A New Deal for Construction

NO STAGE DIRECTOR could have devised a more dramatic climax to the fifteenth annual convention of the Associated General Contractors of America at Washington last month than was furnished by the news, just as the final session was drawing to a close on Jan. 31, that President Roosevelt had signed a basic code of fair competition for the construction industry. The action marks the end of five long months of discussion, negotiation and revision of code terms by representatives of the industry's employing and employee groups and officials of the National Recovery Administration; these men have been in conference almost continuously since the first public hearing last September, and, prior to that, devoted additional months of unselfish labor to preparing the draft of the original code. Now that agreement and ratification have made the code a reality, the construction industry, floundering in a sea of doubt and uncertainty as to the planning, conduct and cost of its work, can chart its course with a clear vision of the standards of practice by which its future operations must be guided. Some of the more important provisions of the new code are summarized in adjoining columns.

For construction, the code means a New Deal of momentous significance and innumerable ramifications. To its objective of establishing competition on a fair basis will be added the transcendent benefit of uniting into a cohesive whole the scattered, independent professional, business and labor elements of an industry whose potential strength and influence have hitherto been curbed by the dispersion of its component parts.

A Basic Code for Construction

● Sponsored by 21 national associations, including the Construction League of the United States, the Associated General Contractors of America, the American Society of Civil Engineers, the American Institute of Architects and the American Road Builders' Association, the basic code for the construction industry, which President Roosevelt approved Jan. 31, constitutes the broad, all-inclusive foundation upon which individual structures of code regulation for various divisions or branches of the industry will be built. As Chapter I, the basic code will form an integral part of all divisional codes, which will appear in the form of succeeding "chapters" for general contractors, professional engineers, architects, and subcontractors for masonry, roofing, heating, plastering and other craft classifications. Under divisional codes there may be sub-divisions covering specialized construction services; the general contractors' division code, for example, is to carry sub-divisional codes for the three major groups of (a) building contractors; (b) heavy construction and railroad contractors; and (c) highway contractors.

Planning and Adjustment Board

● Labor's objections were finally met by providing in the approved basic code for a National Construction Planning and Adjustment Board, without mandatory powers, of 21 members, 10 representing employers, 10 representing labor interests, and 1 disinterested chairman, selected by the President of the United States upon recommendation of the National Recovery Administrator. The stated fundamental purpose of the board is to promote cooperation and good will between industry's employers and employees. It is without mandatory powers and is authorized to "give consideration and make determinations" only on differences regarding wages and hours that may be submitted to it by mutual consent of the employers and employees concerned in the case. The board, therefore, will function without encroaching upon the jurisdiction of the Code Authority, constituted of the employing elements of the industry.

The national board is authorized to set up regional planning and adjustment boards, composed equally of employer and employee representatives.

Scope of Industry

● The term "construction industry", as defined in the code, comprises both the designing (engineers and architects) and constructing elements, including operations of subcontractors.

Hours and Wages

● "Area agreements" as to hours and wages are provided for in the code. In any division of the industry representative groups of employers and employees, by collective bargaining, may establish standards of hours of labor and rates of pay applicable to a specifically defined region, which may include the entire United States. Terms thus agreed to by one division are not binding upon another division of the industry.

In the absence of any area agreement the code fixes 40 cents per hour as a minimum wage rate for unskilled labor. Office and clerical employees are to receive minimum weekly wages of from $15, in large cities, to $12 in cities of less than 2,500 population.

A maximum 40-hour week and an 8-hour day are specified, with exceptions allowing a 48-hour week at camps or floating plants on remotely located projects or to make up, in the following four weeks, time lost by inclement weather on such remote projects or where a sufficient supply of qualified labor is not available, or on emergency work. Employees in professional, executive or supervisory capacities are exempt from the foregoing restrictions as to hours. For employees an age limit of 16 years is set.

By mutual agreement between employees and employers within a division locality the foregoing maximum hours of work may be reduced as a means of sharing work.

Complaint Boards.

● For each division of the industry the Administrator is required to establish one or more boards, each consisting of 2 employer and 2 employee representatives, and an impartial chairman named by the Administrator, to investigate complaints of unfair competition and report findings to the Administrator as a basis for action to enforce code requirements.

Administration

● For purposes of administration a Construction Code Authority and divisional code authorities are established. The former consists of 1 member from each organization sponsoring the code, except the Associated General Contractors, which appoints 4 members, and 3 non-voting members appointed by the Administrator.

The Code Authority is required to establish an Appeals Board of 9 members to consist of 1 architect, 1 engineer, 3 general contractors and 4 subcontractors.

Bids and Awards

● The practices commonly known as "bid peddling" or "bid shopping" are recognized as unfair and are prohibited by the code.

The awarding authority shall not invite bids from a bidder who has not demonstrated that he is competent, technically and financially, to perform the work.

Awards, or rejection of all bids, must be made within 20 days after bids are received. The awarding authority may require the bidder to name his subcontractors.

To Make Public Spending Count

CWA SEEMS TO BE IN FOR AN OVERHAULING. Let us hope that it will be thorough and that the President will stick to his decision to wind it up as soon as may be possble.

As an emergency measure CWA was justified when it was undertaken, but experience to date demonstrates that it suffers from even more than the usual share of defects inherent in emergency measures. On the other hand, PWA was wisely conceived and undertaken as an essential and enduring element of the recovery program. Its purpose is twofold: primarily it is designed to stimulate the heavy industries whose products find so extensive a use in every type of construction; incidentally it was expected to relieve the pressure of unemployment by providing field jobs during the interval required to get the heavy industries under way.

Unfortunately PWA got away to a bad start. Here we need not discuss the blame for that; it is water over the dam. The fact is that PWA was so slow in getting under way that it missed the best part of the 1933 construction season and left us to enter the winter with a huge roll of unemployed in both the capital goods and the service industries.

This situation heightened the concern of the administration over the need for direct employment. Somehow a lot of people must be put to work quickly if we were to reduce the volume of direct relief. Hence the CWA, an emergency measure to tide us over until PWA and private industry could begin to absorb more workers.

But the project suffers from three fatal defects: it was designed to pile the largest possible number of men on each job which inevitably makes for wasteful methods and extravagant expenditure in proportion to the amount of work done. This fault may be condoned, perhaps, on the ground of urgent need that we get men quickly off the relief rolls and on some kind of payroll.

Furthermore the compensation paid to those employed on CWA work was based upon scales that are out of line with the nature of the undertaking and tend to impede rather than to promote the progress of natural recovery. An emergency relief project, designed to create the maximum of employment, is bound to involve wasteful methods and should pay a stipend in keeping with its relief objective. It should not pay wages so large as to attract workers from normal jobs that are managed on a basis of efficient performance and sound public economy. To accomplish our major objective, the influence should be the other way around; compensation should have been so adjusted as to keep the CWA beneficiary constantly on the watch for a "regular job" and therefore a better job.

The third defect of CWA is the policy of handling work through public officials on a day-labor basis rather than by the normal methods, which involve concentrated responsibility for specific performance. It is possible that some modification of the normal contract system might have been necessary but an effort should have been made to work it out. It is not at all surprising that now there are charges of graft and malfeasance; any other outcome from such a procedure would have been astonishing.

Let us repeat: we can see many reasons why, under the pressure of so great an emergency, this plan should have been adopted in spite of these defects. But we can see no reason why it should be continued for one hour beyond the earliest moment at which its affairs can be wound up. It was a measure of desperation, bound to breed irresponsibility, waste, maladministration and worse. The sooner we can transfer its deserving beneficiaries to productive jobs the sooner we shall begin to forward the process of recovery.

Let us then speed up the PWA projects and prosecute them through responsible construction organizations, competent to render the largest return to the taxpayers for each dollar of expenditure; let us use normal methods and equipment thereby making further for more efficient operation and forwarding the major purpose of PWA, which is to create a demand for the products of the heavy industries, now the drag on normal recovery.

Thus only can public spending meet the requirements of real progress.

Willard Chevalier

Publishing Director

CONSTRUCTION METHODS. February, 1934. Volume 16, Number 2. Published monthly, price 10¢ a copy. Subscription rates—United States, Mexico and Central and South American countries, $1.00 a year. Canada, including duty, $1.50 a year. All other countries, $2.00 a year or 8 shillings. Entered as second class matter October, 1926, at Post Office at New York, N. Y., under the act of March 3rd, 1879. Printed in U.S.A. Cable address "McGrawhill, New York." Member of A.B.P. Member of A.B.C. Copyright 1933 by McGraw-Hill Publishing Co. Inc., 330 West 42d Street, New York, N. Y.

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

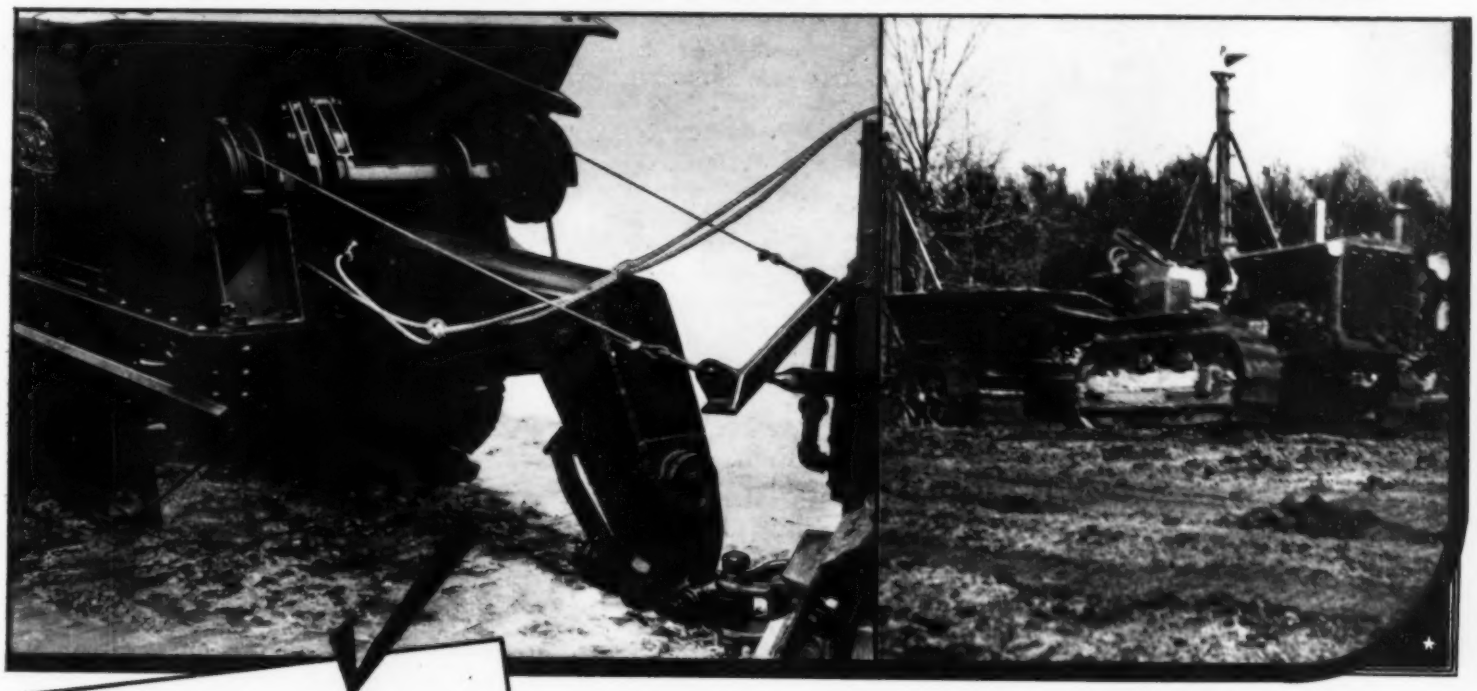
Editorial and Publishing Offices: 330 West 42d St., New York; 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, W. C. 2, England. Branch Offices: Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Greenville, S. C. James H. McGraw, Chairman of the Board; Malcolm Muir, President; James H. McGraw, Jr., Vice-President and Treasurer; Mason Britton, Vice-President; Edgar Kobak, Vice-President; H. C. Parmelee, Vice-President; Harold W. McGraw, Vice-President; B. R. Putnam, Secretary.

CONTRACTORS—here is the simplest—most practical automatic dump and wind mechanism built. For use on bottom dump crawler wagons, it is operated entirely by the tractor driver and shows actual savings on both hauling time and labor costs. Its non-complicated design and principle of action insures positive operation under all kinds of working conditions. *Exhaustive tests on various winter jobs have proved this to be a fact

** 80 Wagons have been completely equipped with Euclid Winds due directly to contractors seeing or hearing of the aforementioned tests.*

SPEED-UP THE JOB . . REDUCE YOUR COSTS WITH

EUCLID *Automatic Winds*



CHECK THESE FEATURES

- Operated entirely by the tractor driver.
- Doors are quickly closed tight by power gained from the motion of the tractor
- No manual labor is required whatsoever
- Simple design—works freely under all conditions
- Mounted high-up on the wagon away from dirt — protected from loading by top shield
- Fits all makes of crawler bottom dump wagons
- Easily installed in the field in several hours time
- Moderate cost—pays for itself in a few weeks of operation

METHOD OF OPERATION—Euclid Automatic

Winds are controlled entirely by the tractor driver with practically no effort and very little attention on his part. A pull on a rope lets the doors drop free for the load to spill. Pulling on a second rope engages the clutch and the wind-up action starts with the slightest motion of the tractor. This is accomplished through the use of two cables which extend from the winding-drum shaft to the tractor. Every motion of the tractor pulls on these cables, turning the winding-drums which lifts both doors simultaneously. Full benefit of the slightest move on the part of the tractor is gained through the use of a take-up spring which serves to keep the cables to the tractor taut. As a rule, a half turn in either direction and a consequent straightening-out of the tractor affords sufficient motion to completely wind up the doors. When the doors are returned to a fully closed position—the wind-up action is automatically released.

For further information and prices, see your Euclid Dealer or communicate directly with this Company, listing the number and makes of wagons operated.

THE PIONEER

THE EUCLID ROAD MACHINERY CO.

CLEVELAND OHIO

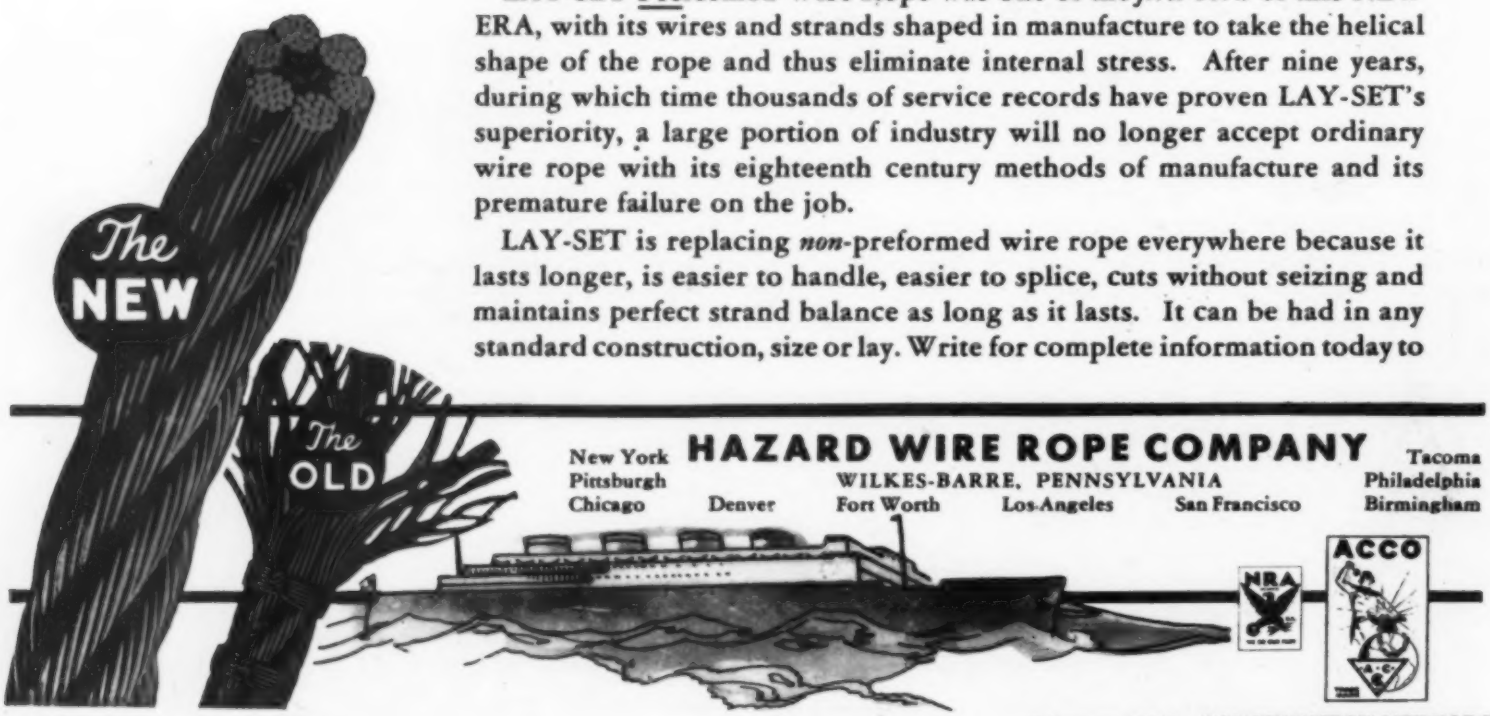
FORWARD!

INDUSTRIAL America is again the Mother of giants . . . Full-grown at birth, these giants are already abroad revolutionizing our national industrial life.

. . . Streamline trains which will operate at 120 miles an hour . . . 70 octane gasoline . . . stabilizers for ocean-going liners . . . Pan-American air service . . . air conditioning for the Tropics . . . and PREFORMED WIRE ROPE, the greatest basic improvement in this field of industry for over 75 years.

LAY-SET Preformed Wire Rope was one of the *first-born* of this NEW ERA, with its wires and strands shaped in manufacture to take the helical shape of the rope and thus eliminate internal stress. After nine years, during which time thousands of service records have proven LAY-SET's superiority, a large portion of industry will no longer accept ordinary wire rope with its eighteenth century methods of manufacture and its premature failure on the job.

LAY-SET is replacing *non*-preformed wire rope everywhere because it lasts longer, is easier to handle, easier to splice, cuts without seizing and maintains perfect strand balance as long as it lasts. It can be had in any standard construction, size or lay. Write for complete information today to



New York Pittsburgh Chicago Denver **HAZARD WIRE ROPE COMPANY** WILKES-BARRE, PENNSYLVANIA Fort Worth Los Angeles San Francisco Tacoma Philadelphia Birmingham

NRA

ACCO

80,000 MILES OF *Rough* ROAD-BUILDING SERVICE *with* Firestone TRUCK *and* BUS TIRES

THERE is no tougher test for tires than road building — particularly in country where rock blasting is necessary. Mr. Magee, of the Walter W. Magee Company, in his letter mentions service in excess of 80,000 miles. Here is tire performance—such a demonstration of ruggedness is evidence that Firestone High Speed Tires will give you more satisfactory performance on your fleet. The Firestone patented process of Gum-Dipping the High Stretch Cords provides the *extra strength* and *resistance* against abuse as well as adding to the mileage to be secured in severe service.

Get your trucks ready for the increasing number of road building projects and contracts — equip with Firestone High Speed Tires for *dependable low cost* operation.

GARFIELD 1039

Walter W. Magee Company
GENERAL CONTRACTORS
118 W. CENTRAL AVENUE
ST. PAUL, MINN.

BUILDINGS
BRIDGES
FOUNDATIONS
GRADING
PAVEMENTS
SEWERS
WATER WORKS

July 6, 1933

Mr. W. F. Smith,
W. F. Smith Tire & Battery Co.,
St. Paul, Minn.

Dear Mr. Smith:

We have just completed our road building project at Grand Marais in Northern Minnesota.

This project consisted of blasting and moving three hundred thousand yards of rock and two hundred and fifty thousand yards of dirt. The hauling conditions were most severe subjecting our trucks and tires to the most gruelling tests in our experience.

In making a survey of our equipment and costs, we were agreeably surprised with the low cost of our Firestone Tires.

You will be glad to know of the performance of our tires in this work. In spite of this abuse and punishment our tires received, we find some of them withstood this service for 80,000 miles. We consider this most phenomenal and far superior to the service anticipated.

We know that your tires have saved us a considerable sum of money, and in addition the prompt, efficient service rendered by all your organization has been of great value to us. We are enclosing a photograph of the fifteen new trucks equipped with Firestone tires which have just been purchased to enlarge our present fleet of fifty-five.

Yours very truly,

WALTER W. MAGEE COMPANY

wwmagee

NRA MEMBER U.S. WE DO OUR PART

Listen to the "Voice of Firestone" Every Monday Night Over N. B. C.-WEAF Nationwide Network

FIRESTONE TIRES WILL REDUCE *Your* OPERATING COSTS

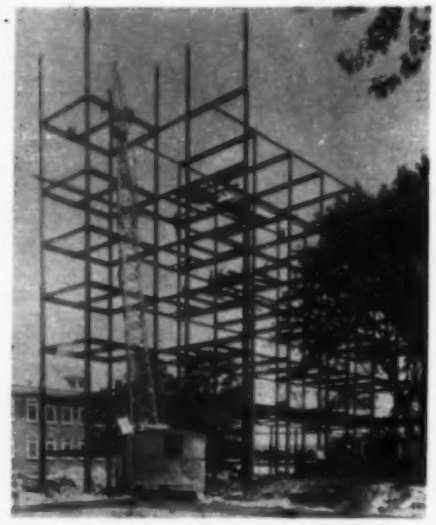
Copyright, 1934, The Firestone Tire & Rubber Co.

YOU CAN PROFIT *by these* EXPERIENCES

What Users say about the Performance of these

LINK-BELTS

"Have used many other makes of machines and consider the Link-Belt far superior in durability, capacity, ease of operation and low maintenance cost."



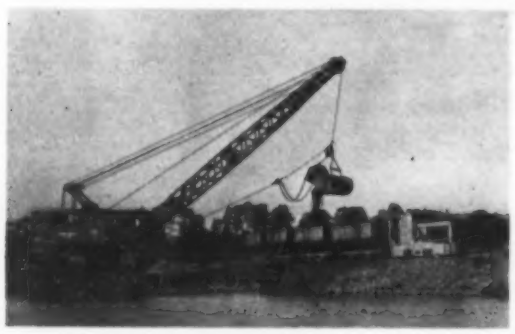
"Have two Link-Belts. Cannot say enough for their performance. Have operated them on every type of work a crawler machine can be called upon to handle."

"Have used Link-Belts for five years. They have always held up their end on every job. Maintenance cost is extremely low. The most accessible machine we have had experience with."

"We find that the Link-Belt is the most dependable and lowest in upkeep."

"We own four Link-Belts. Would not consider any other shovels. Fast; dependable."

"Have five Link-Belts. They cost less to operate and will produce more yardage."



"Have seven Link-Belts. Operation cheapest. Capacity largest. Satisfaction perfect."

"Have nothing to say but the best for the performance of these machines."

"Consider it a good investment. Best machine we have ever owned."

Let a Link-Belt carry the profit burden on your next job. From ¾ to 2½ yds. capacity, heavy-duty built. Gasoline engine, Diesel or electric motor drive.

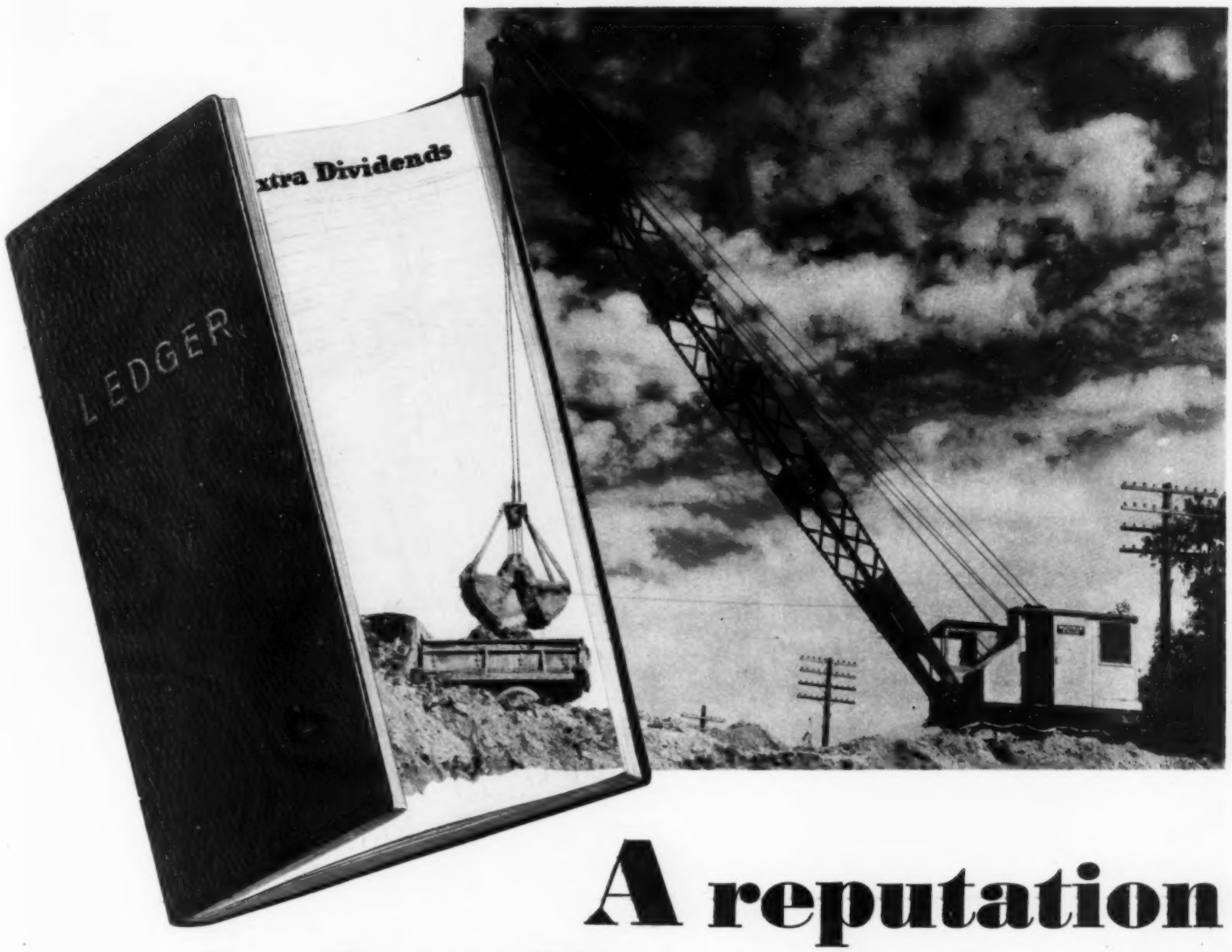
LINK-BELT COMPANY

300 West Pershing Road, Chicago — Offices and Distributors in All Principal Cities

4913-A

LINK-BELT

SHOVEL-CRANE-DRAGLINE

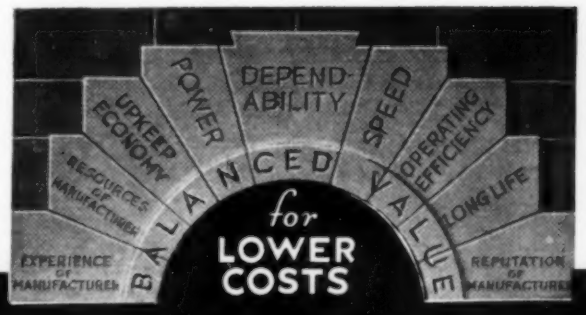


A reputation ... for long-life performance!

The machine that is built with the staunch dependability to give you the maximum years of profitable service, may be depreciated on your books, at a minimum life expectancy. But after it has been charged off, it can pay extra dividends by going right on moving dirt efficiently and economically as in the days of its youth. When the time comes to dispose of it, you can move it more readily, and secure a higher price, if the name it bears carries a reputation for long-life performance.

Many Bucyrus-Erie machines built twenty to thirty years ago are still in service today.

BUCYRUS-ERIE COMPANY, South Milwaukee, Wis.

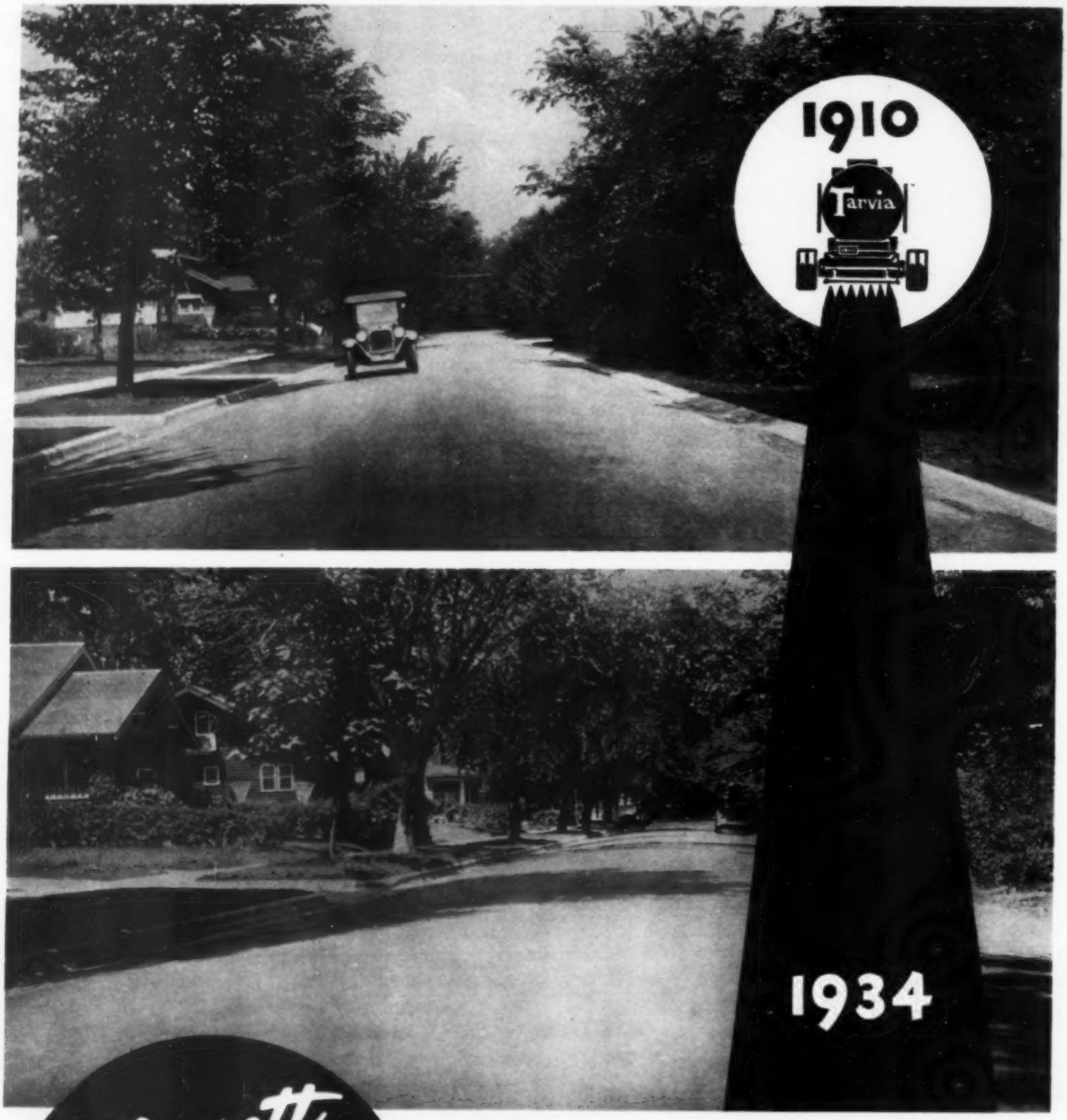


All sizes: ½- to 20-yards . . . shovels; draglines; dragshovels; skimmer scoops; cranes; clamshells; dredges; tower excavators; tunnel shovels; Bucyrus-Mcnighan walking draglines . . . gasoline, Diesel, electric, Gas+Air, Diesel-electric, and steam powered . . . railway cranes; spreader plows; ballast plows; Loadmaster cranes; Red Arch dragline buckets; Bucyrus-Armstrong blast hole drills, well drills, tools and drill sharpeners.

698

See BUCYRUS ERIE *before you buy!*

Marston Avenue, Madison, Wisconsin. Tarvia-built in 1910, the year Glenn Curtiss flew from Albany to New York to win a $10,000 prize. Upper photo was taken in 1920; lower photo shows the road today. After 24 years of ever-increasing traffic, it is in first-class condition.



Barrett Tarvia
GOOD ROADS AT LOW COST

Tarvia roads are as permanent as any surfaced roads can be. They are uniformly good—smooth, easy-riding, skid-safe. They may be built with inexperienced labor, and they cost less per mile and less per year of service. Tarvia service records, maintained over a period of thirty years, prove it. The Tarvia field man is competent to assist you with any highway problem. 'Phone, wire or write.

THE BARRETT COMPANY

New York	Chicago	Philadelphia	Toledo	Boston
St. Louis	Lebanon	Minneapolis	Cleveland	Milwaukee
Detroit	Baltimore	Columbus	Youngstown	Birmingham
Buffalo	Providence	Syracuse	Hartford	Cincinnati
	Bethlehem	Rochester	Portland, Me.	

THE BARRETT COMPANY, LTD. Montreal Toronto Winnipeg Vancouver

and back in old

NEW ENGLAND

the evidence is piling up—

F'rinstance here's:

C. W. BLAKESLEE & SONS

Of New Haven, Conn. They are about to go to work on a PWA project with their brand new

P & H MODEL 600 SHOVEL

WITH SPLIT SECOND CONTROL

BACKED BY 50 YEARS OF EXPERIENCE

Wherever men buy on EVIDENCE OF SUPERIORITY, you'll find 'em picking and sticking to P&H — because it has been proved they're faster, more powerful, capable of turning out a bigger day's work for less money.

HARNISCHFEGER CORPORATION

4494 W. NATIONAL AVENUE — Established 1884 — MILWAUKEE, WISCONSIN

WAREHOUSES AND SERVICE STATIONS:

HOBOKEN MEMPHIS JACKSONVILLE SEATTLE DALLAS LOS ANGELES SAN FRANCISCO

In 1922 the United States Pipe and Foundry Company shipped the first length of de Lavaud centrifugally cast pipe commercially produced in the United States. By 1932 more than 80 million feet of de Lavaud pipe had been installed in the United States alone. Every length of those 80 million feet may be confidently expected to surpass, under equal conditions, the long-life records of cast iron pipe made a century ago. For de Lavaud pipe since the first shipment in 1922 has been stronger cast iron pipe than our best pit cast pipe. It has rightfully been considered ideal pipe for service underground.

Now we are ready to announce Super-de Lavaud Pipe

with impact-resistance increased 100 per cent

IT will be recognized that the hazard of incipient rupture in the handling of pipe in transit, unloading and distributing is beyond the control of the manufacturer.

In 1930, the United States Pipe and Foundry Company undertook the self-imposed task of reducing that hazard in the only way possible—by increasing the impact-resistance of the pipe and at the same time maintaining a sound balance between modulus of elasticity and modulus of rupture. In that year of depression, we built and equipped one of the finest foundry research laboratories in the world.

In 1932, we began to produce at our Burlington plant, and later at other plants, a Super-de Lavaud Cast Iron Pipe, centrifugally cast, by a new patented process developed in our Research Laboratory. The outstanding feature of this new pipe is an extraordinary increase in impact-resistance.

For thirteen months we have been in production. During this time all our centrifugally cast pipe has been made by the new Super-de Lavaud process. After a year's experience in production and shipments we are now ready to announce that:

SUPER-DE LAVAUD CAST IRON PIPE, centrifugally cast by our patented improved process, is *shatter-proofed* to the extent that *impact-resistance has been increased more than 100 per cent.* Thus, maximum protection against hazards of handling and transporting has been built into Super-de Lavaud Pipe in order that pipe which is perfect *for service underground* shall remain perfect *from plant to underground.* While the human element in handling pipe is always unpredictable, it now becomes a negligible factor under any but abnormal conditions in transit, unloading and laying.

The major advantage resulting from the extraordinary increase in the impact-resistance of Super-de Lavaud Pipe is in protection against the hazard of damage in handling and transit but it must be obvious that this pipe will render super-service underground. Super-de Lavaud Pipe establishes a standard of its own exceeding the requirements of the Federal Specifications Board for this product. *Send for descriptive booklet.*

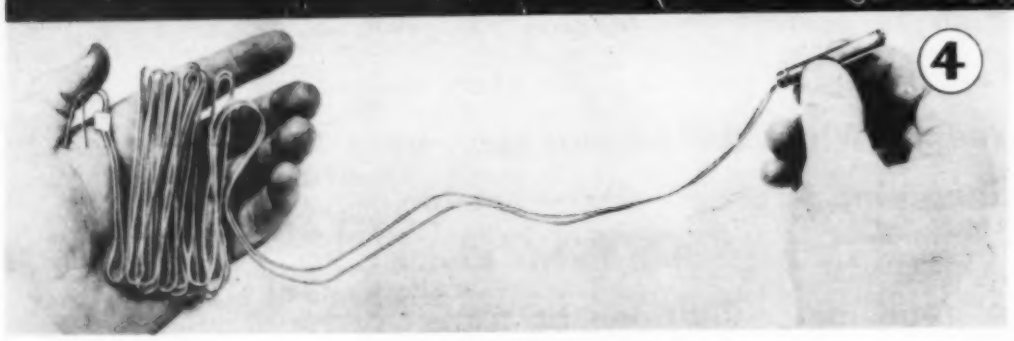
UNITED STATES PIPE AND FOUNDRY COMPANY

GENERAL OFFICES . . . . BURLINGTON, N. J.

FOUNDRIES AND SALES OFFICES THROUGHOUT THE UNITED STATES

1 A SAFE, handy package—no exposed metal — the wires encase the blasting cap to protect the detonation from all external shock.

2 The package is easily opened—a simple pressure of the fingers and it breaks along the indented line.



3 The wires are folded accordion-wise so that they extend naturally into position.

4 It is easy to straighten out the cap end for priming without disturbing the rest of the accordion fold.

ATLAS
ACCORDION FOLD
Electric Blasting Caps

A simple innovation has accomplished a revolutionary advance in safety and convenience. The pictures tell the simple story—but what a significant story it is for the electric blaster. Now, electric blasting caps are carried handily and safely, with the wires conveniently folded accordion-wise to straighten into position, avoiding the tendency to kink and snarl.

The orange Atlas Accordion Fold package denotes iron wire; the green tube, copper wire. The accordion fold package is an exclusive Atlas idea—a new standard of easy handling for all who use electric firing.

ATLAS POWDER COMPANY

A proper explosive for every blasting requirement

WILMINGTON · DELAWARE

Cable Address—ATPOWCO

BRANCH OFFICES:

Allentown, Pa.; Boston, Mass.; Denver, Colo.; Houghton, Mich.; Joplin, Mo.; Kansas City, Mo.; Knoxville, Tenn.; Memphis, Tenn.; New Orleans, La.; New York, N. Y.; Norristown, Pa.; Philadelphia, Pa.; Pittsburg, Kansas; Pittsburgh, Pa.; St. Louis, Mo.; Tamaqua, Pa.; Wilkes-Barre, Pa.

ATLAS EXPLOSIVES

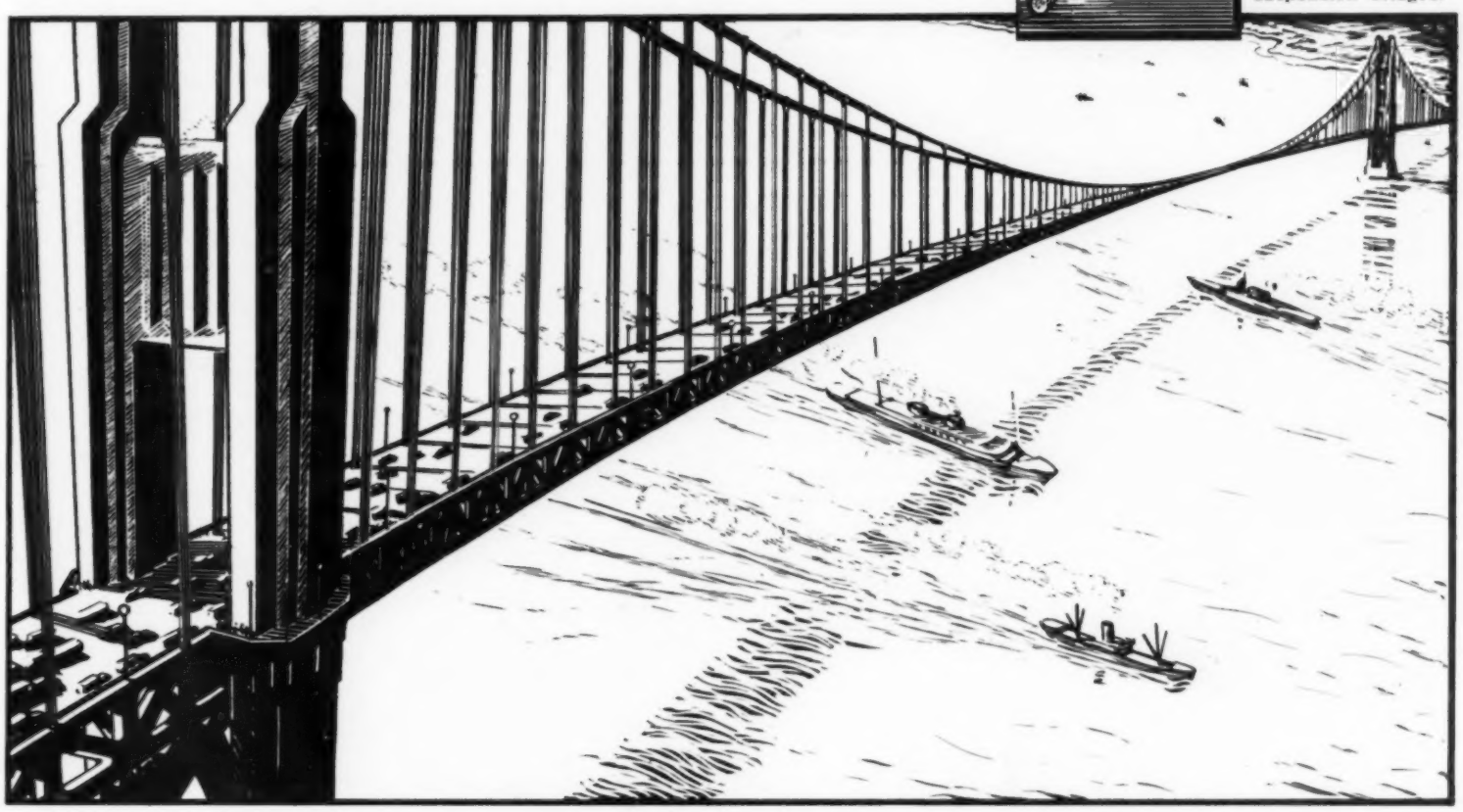
80,000 MILES OF WIRE

in Golden Gate Bridge Cables

22,000 Ton Cables to be spun by Roebling ...of Roebling Open-hearth Steel Wire... famed for strength, toughness and stamina

Golden Gate Cables will be 36½" in dia.

IN CONTRAST, a ¾" Roebling Bridge Cable for small suspension bridges.



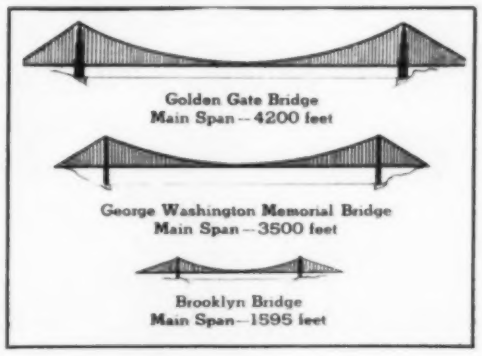
Artist's conception of the great suspension bridge which will span San Francisco's renowned Golden Gate. Roebling will furnish main cables, suspenders, and cable accessories.

BRIDGE HISTORY is being made in San Francisco. A new king of suspension bridges.... the Golden Gate.... soon will be crowned. It will be the longest single clear span in the world.

Just try to picture this new ruler of the bridge world! Its main span will be almost three times the length of the main span of the famous Brooklyn Bridge. It will have the highest and largest bridge towers in the world.

80,000 miles of Roebling Wire will be used for the two main cables.... enough wire to girdle the globe three times. Each cable will be 36½ inches in diameter, weigh 11,000 tons, and contain 27,572 separate wires. Load supporting capacity of the two cables: 215,000 tons.

For over 90 years Roebling has been the pacemaker in the development of wire rope and bridge cable. Full recognition of this fact is evidenced by the widespread use of these Roebling Products for every need from the largest to the smallest. They assure the highest obtainable degree of safe, dependable, economical service.



WIRE ROPE FOR ALL NEEDS... LARGE OR SMALL: No matter how exacting the service, or how large or small the order may be, Roebling can meet your requirements. And your order will receive the same careful, prompt attention, whether for a carload of rope or merely a few feet. John A. Roebling's Sons Company, Trenton, N.J. Branches in Principal Cities.

ROEBLING

The Pacemaker in Wire Rope and Bridge Cable Development

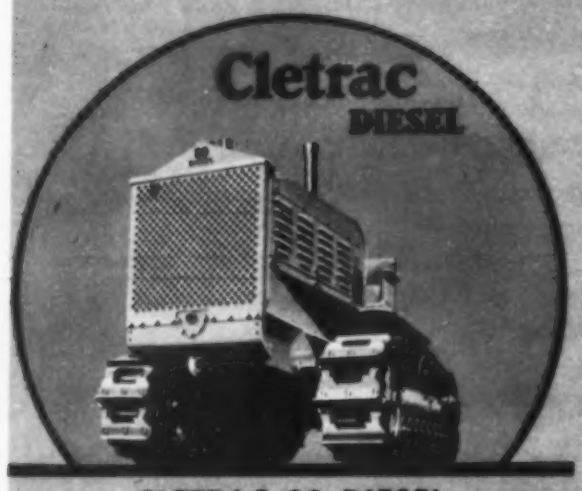
not all Crawler tractors are CLETRACS

..those are which speed road construction and maintenance at lower costs

FROM MAINE TO CALIFORNIA—on road construction and maintenance work—Cletracs are establishing new records of performance—in economy, in reliability—with modern equipment. Contractors as well as state, county and township officials join in these reports. Out of 20 state highway departments placing orders for crawler tractors in 1933, 17 specified Cletracs.

The reason for this outstanding preference is due to Cletrac's 22 advanced and exclusive features of design and construction. These include Controlled Differential Steering, which gives power on both tracks when turning—centralized, continuous lubrication of all moving parts—improved track support—full electric starting equipment as standard—most horsepower per pound of weight and lower operating and maintenance costs.

Better be safe than sorry—see what Cletrac gives before you buy.

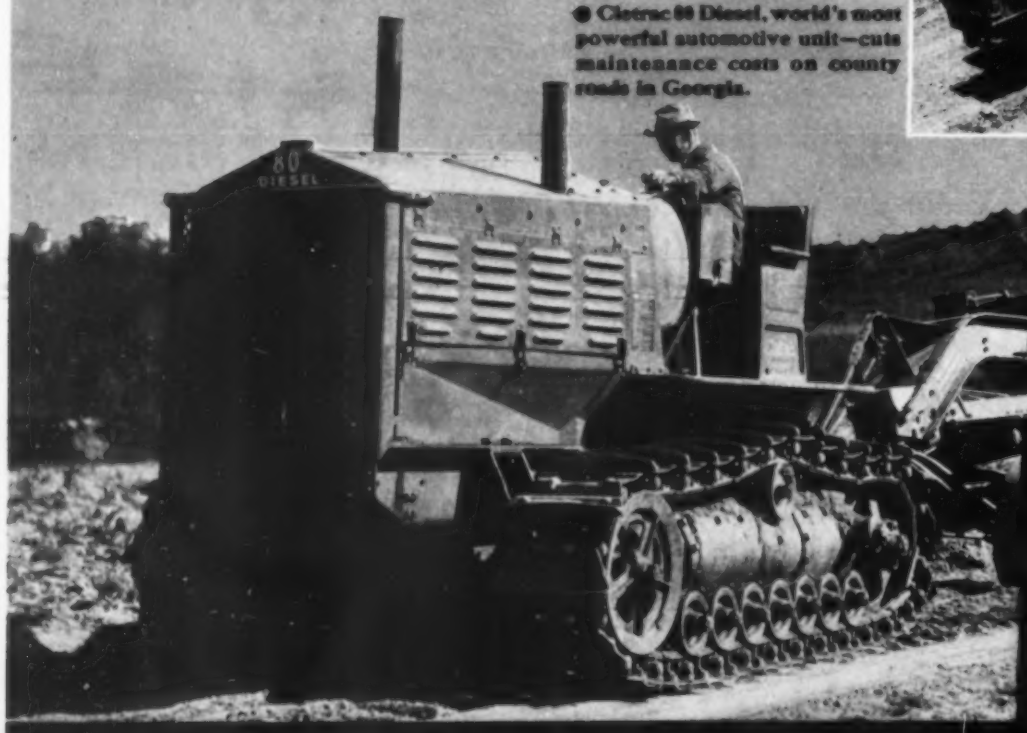


CLETRAC 80 DIESEL

Cletrac's latest contribution to lower costs. The Cletrac 80, world's most powerful automotive unit with a Diesel motor of advanced design, developing 85 horsepower in second gear. By standardizing on Cletracs you may now secure machines of similar construction and operating requirements, powered according to your needs and preferences, either with Diesel or standard gasoline motor.

● CLETRAC 80's set new records on this highway construction in California—54 cubic yards per hour over a 4000-ft. round trip haul, 1100 feet of which averaged a 14% grade.

● Cletrac 80 Diesel, world's most powerful automotive unit—cuts maintenance costs on county roads in Georgia.



Cletrac
Crawler Tractors
Built To Endure

FREE—*Valuable Information*

On request we will gladly send valuable literature giving detailed information about Cletrac's exclusive cost-reducing features and examples of their use in road work

Name_____

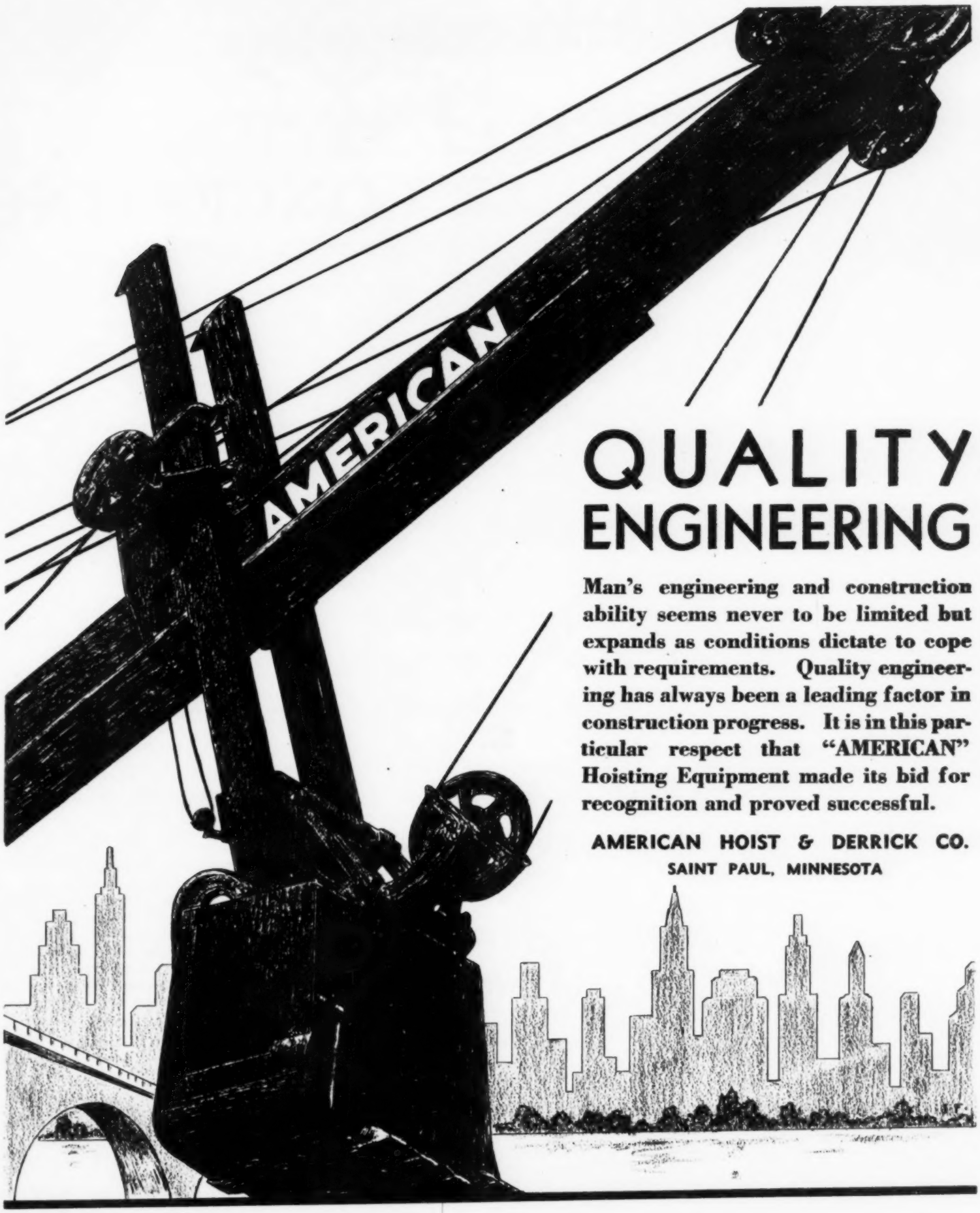
Company and Position_____

Address (Street)_____

City and State_____

..THE CLEVELAND TRACTOR CO.

CLEVELAND, OHIO, U.S.A. CABLE ADDRESS "CLETRAC"



QUALITY ENGINEERING

Man's engineering and construction ability seems never to be limited but expands as conditions dictate to cope with requirements. Quality engineering has always been a leading factor in construction progress. It is in this particular respect that "AMERICAN" Hoisting Equipment made its bid for recognition and proved successful.

AMERICAN HOIST & DERRICK CO.
SAINT PAUL, MINNESOTA

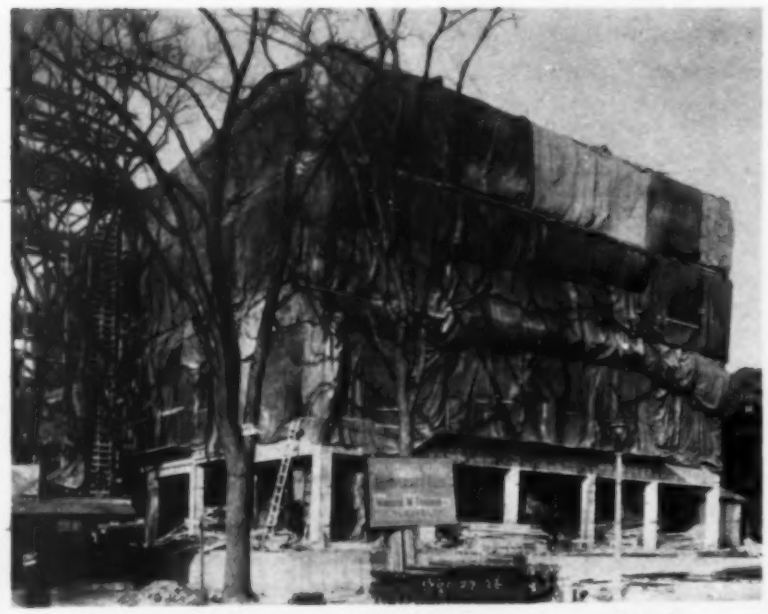
AMERICAN GOPHER

SHOVEL—CRANE—DRAGLINE
5 SIZES

DERRICKS—HOISTS—REVOLVERS
PILE DRIVERS—LOCOMOTIVE CRANES

That Old Man Winter Takes a Licking on

COLD-WEATHER CONCRETING



Heating mixing water, heating aggregates, complete inclosure of structures . . . these are some of the simple cold-weather methods.

PRODDED by the need for going ahead with projects in coldest weather this winter, contractors in most of the country north of the Mason-Dixon line are tussling again with Old Man Winter and those tough twins of his—Freezing and Thawing.

That near-zero temperatures play havoc with freshly placed concrete, insufficiently protected, is a thoroly established fact. However, contractors, not easily discouraged, have learned effective tricks of their own since the days when the first blasts of cold weather drove reputedly hard-boiled old-timers indoors to sit with folded hands by the fire. Heating mixing water and aggregates, tarpaulin and straw protection of fresh concrete, complete or partial inclosure of structures, strategic use of steam or salamanders — these are some of the workable methods which, if followed, produce quality concrete under even worst cold weather conditions.

Still, now and then, there are special jobs of winter concreting that raise bothersome problems. To quickly and conveniently get helpful information on these, construction men are often turning to those whose special job it is to know concrete from A to Izzard—the cement people.

Builders who have written to the Universal Atlas Cement Co. for example, to get advice on some project hampered by freezing weather, have found that an early mail brings comprehensive, directly helpful information on cold-weather concreting. Backed by such information and their own-hard-won experience, they have licked Old Man Winter more times than he likes to tell, in getting concrete mixed, placed and cured *right*, regardless of nasty weather and stubborn jobs.

Next time you run into a snag on concrete, be it a winter-weather job or some other kind of a puzzler, give Universal Atlas a chance to help you wrestle with it. Write or phone the office nearest you (see check-list at left) and spill your troubles. You'll get good, sound, intelligent advice —and, naturally, there will be no charge for it—it's a regular part of every barrel of Universal Atlas cement that goes to make good concrete.

Check-List for Getting Concrete Information

Prompt advice on concrete problems from these Universal Atlas Cement Co. offices:

New York—Chrysler Building
Pittsburgh—Frick Building
Birmingham—Brown-Marx Bldg.
Waco—425 Austin Ave.
Kansas City—911 Walnut St.
Minneapolis—405 Second Ave., S.
Chicago—208 South La Salle Street

Not easily discouraged, contractors have learned some effective tricks of their own that eliminate much worry from cold-weather concreting.

Tussling again with Old Man Winter and those tough twins of his — Freezing and Thawing, contractors go ahead in coldest weather.

(This page is an advertisement presented by the Universal Atlas Cement Co., Subsidiary of United States Steel Corporation)

Construction Methods

Established 1919—McGraw-Hill Publishing Company, Inc.

ROBERT K. TOMLIN, Editor

Volume 16—Number 2—New York, February, 1934

COFFERDAM on Tennessee River rushed to completion to enclose site for power house for General Joe Wheeler Dam upstream from Muscle Shoals.

T. V. A. Makes Quick Start on WHEELER DAM

WHEN THE Tennessee Valley Authority was ordered recently by President Roosevelt to undertake immediately the construction of Dam No. 3 (General Joe Wheeler Dam) on the Tennessee River 15 mi. above Wilson Dam at Muscle Shoals, Ala., the organization literally was caught flat-footed, since there was no expectation that an early start would be made on this project, estimated to cost $22,000,000. The organization already set up by the Authority, however, had been so planned that it was able to take on this great job practically in its stride.

Location of the dam had been determined by the construction of a lock at the north end, as described elsewhere in this issue. There was thus no alternative except to proceed with the building of the power house and spillway at the crossing of the river contemplated when this lock was started.

T. V. A. had determined the policy of having A. E. Morgan, chairman of the board, handle all construction projects undertaken by the latter. C. H. Locher had been retained as construction consultant. From the list of qualified applicants on whom the T. V. A. had passed, Lee H. Huntley, as engineer of construction, and W. M. Hall, as construction superintendent, were selected and on the job in a matter of days.

Meantime, the T.V.A. had arranged with the Corps of Engineers, U.S.A., to use a number of floating derricks, tow boats and barges that were on the Tennessee River. Orders also were placed for prompt delivery from nearby mills of the large amount of lumber needed for the cofferdams. In this way work was in full swing almost immediately after the order to go ahead was received.

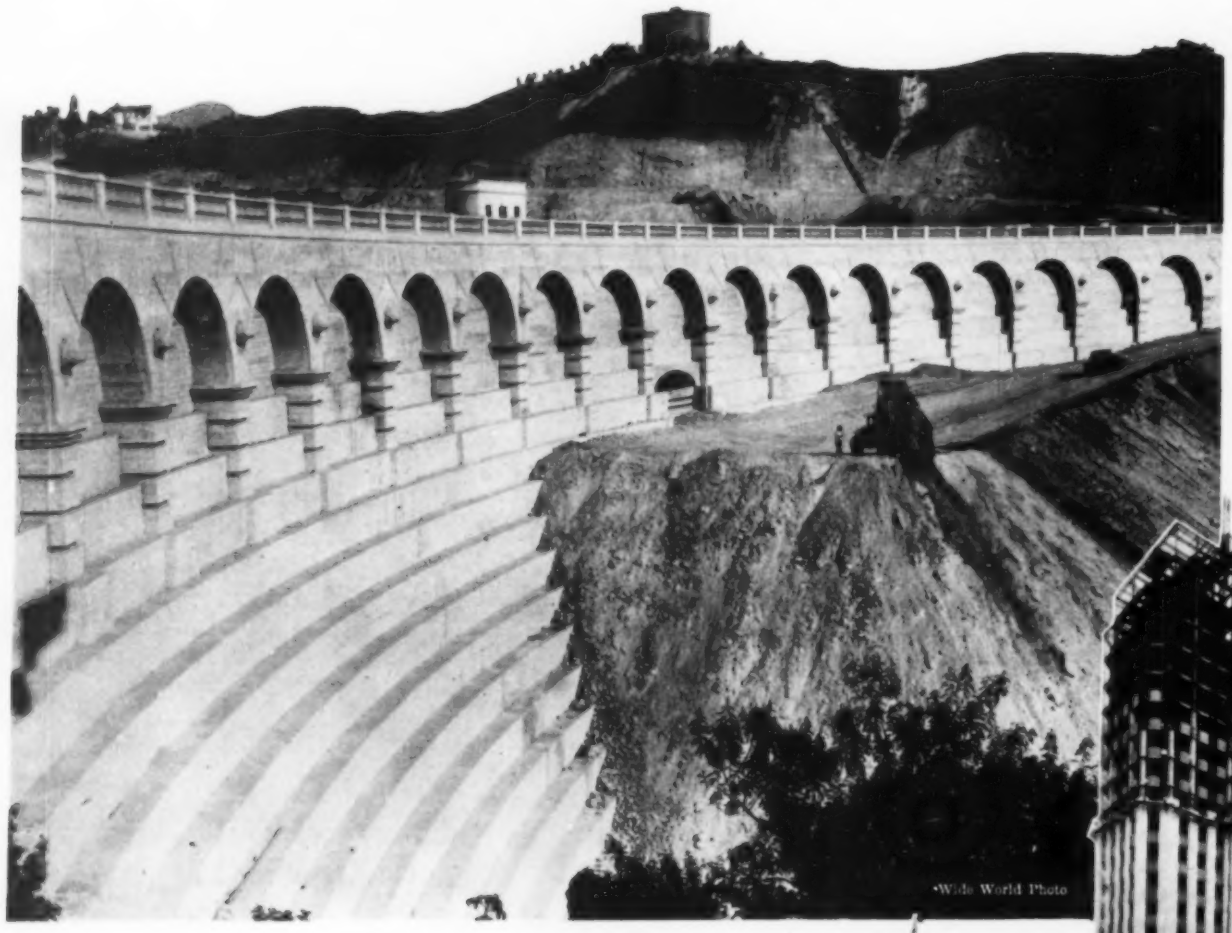
With the lock on the north bank already well along under a previous contract, the power house had to be placed adjacent to the south bank. T.V.A. engineers had not decided on the design of the spillway and power house. But it was possible to build the upstream leg of the cofferdam to inclose the power-house site while the design of the substructure was being determined. By the time this leg was completed the length of the power-house substructure was fixed, so that the turn downstream on the outer leg of the cofferdam could be made. Before that leg was completed the engineers had determined where the downstream cofferdam ought to be. Thus the job went right ahead, a matter of hours, in one case, behind the design.

In the accompanying view the largely completed lock on the north bank may be seen faintly 6,000 ft. away. The cofferdam enclosing the power-house site is practically completed. As soon as it is ready, it will be unwatered and removal of the rock necessary to prepare the foundation will be undertaken with large electric power shovels.

Slack water from the Wilson Dam, combined with regulating works of the latter, reduce variations in the stage of the river at this site to about 1.5 ft. This simplifies the problem of handling construction. Provision must be made, however, for passing a vast flow over the site during construction. By building the power house first, all of the openings in the latter will be available for this purpose when the closure of the spillway was accomplished.

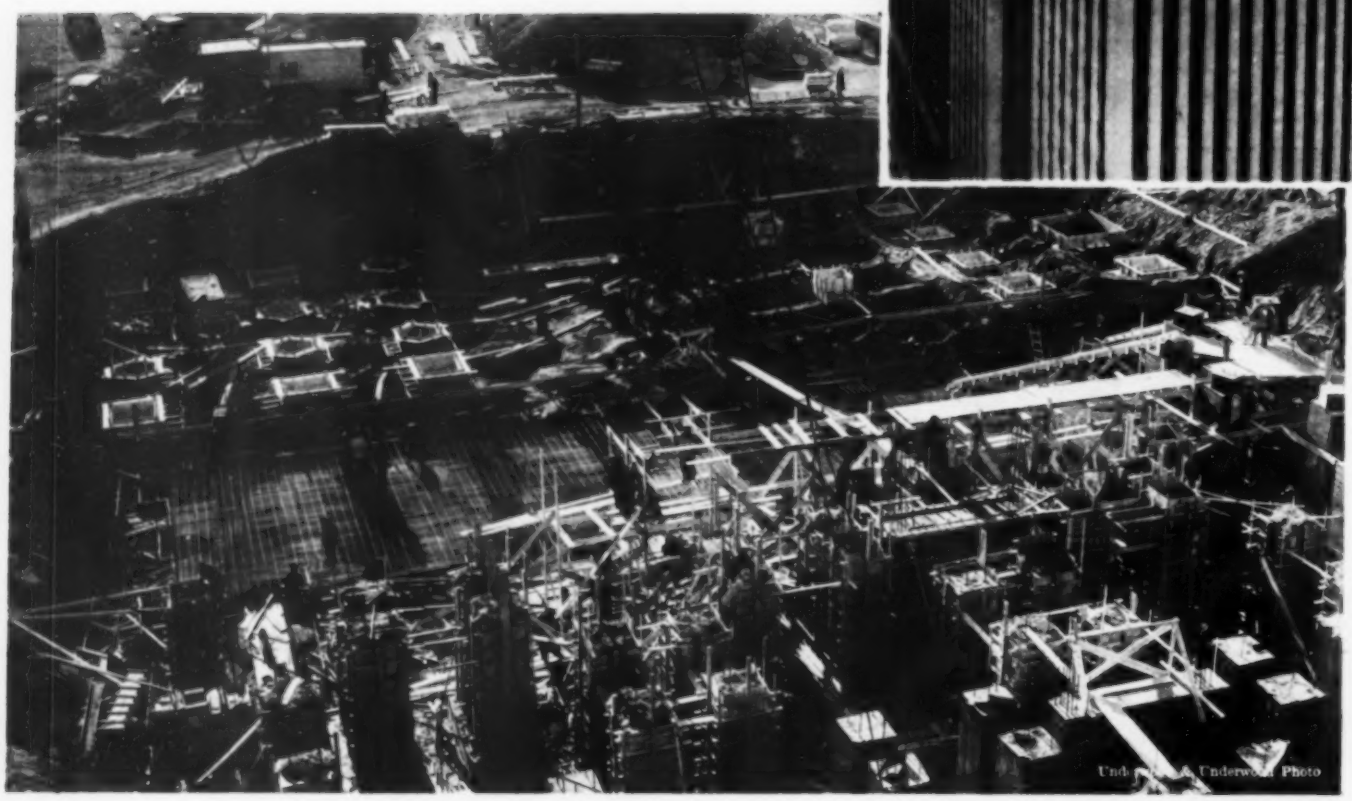
This Month's

"NEWS REEL"



EARTH-AND-ROCK FILL *(left)* of 285,000 yd. is being placed against downstream face of Mulholland Dam in hills above Hollywood, Calif., to protect population below from danger of failure caused by earthquake or foundation defect. Storage in reservoir has been reduced by Los Angeles Department of Water and Power from 7,200 acre-ft. to 4,200 acre-ft.

42-STORY TOWER of Field Building *(below)* approaches full height of 535 ft. as third section of Chicago's largest office structure nears completion. Design features are similar to those of first unit, described in *Construction Methods*, July, 1932, pp. 23-27. Third unit completes building, which has gross floor area of 1,400,000 sq. ft. and rentable area of 1,000,000 sq.ft. George A. Fuller Co., general contractor; Graham, Anderson, Probst & White, architects.



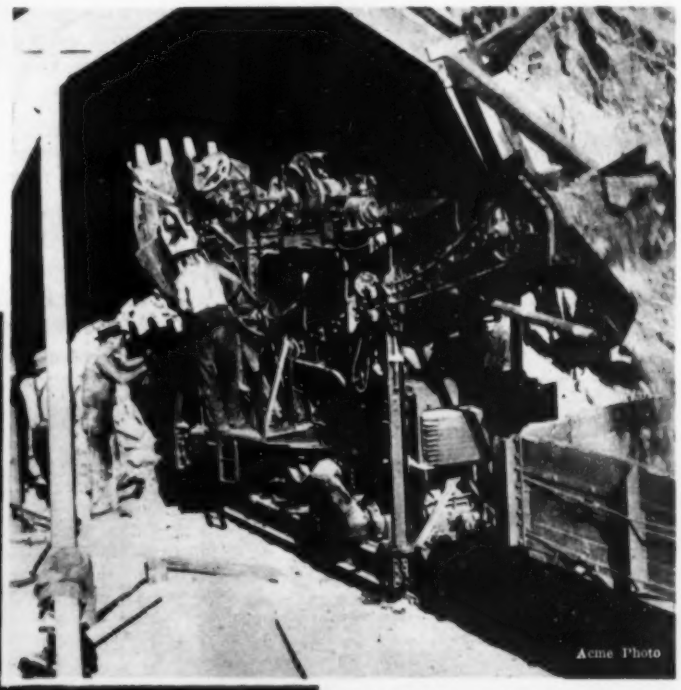
DESERT BLOOMS AGAIN *(left)* as foundations for $4,000,000 distillery, reputed to be world's largest, rise above general excavation level at Peoria, Ill. These concrete piers will support 24 fermenters, each holding 120,000 gal. of mash.

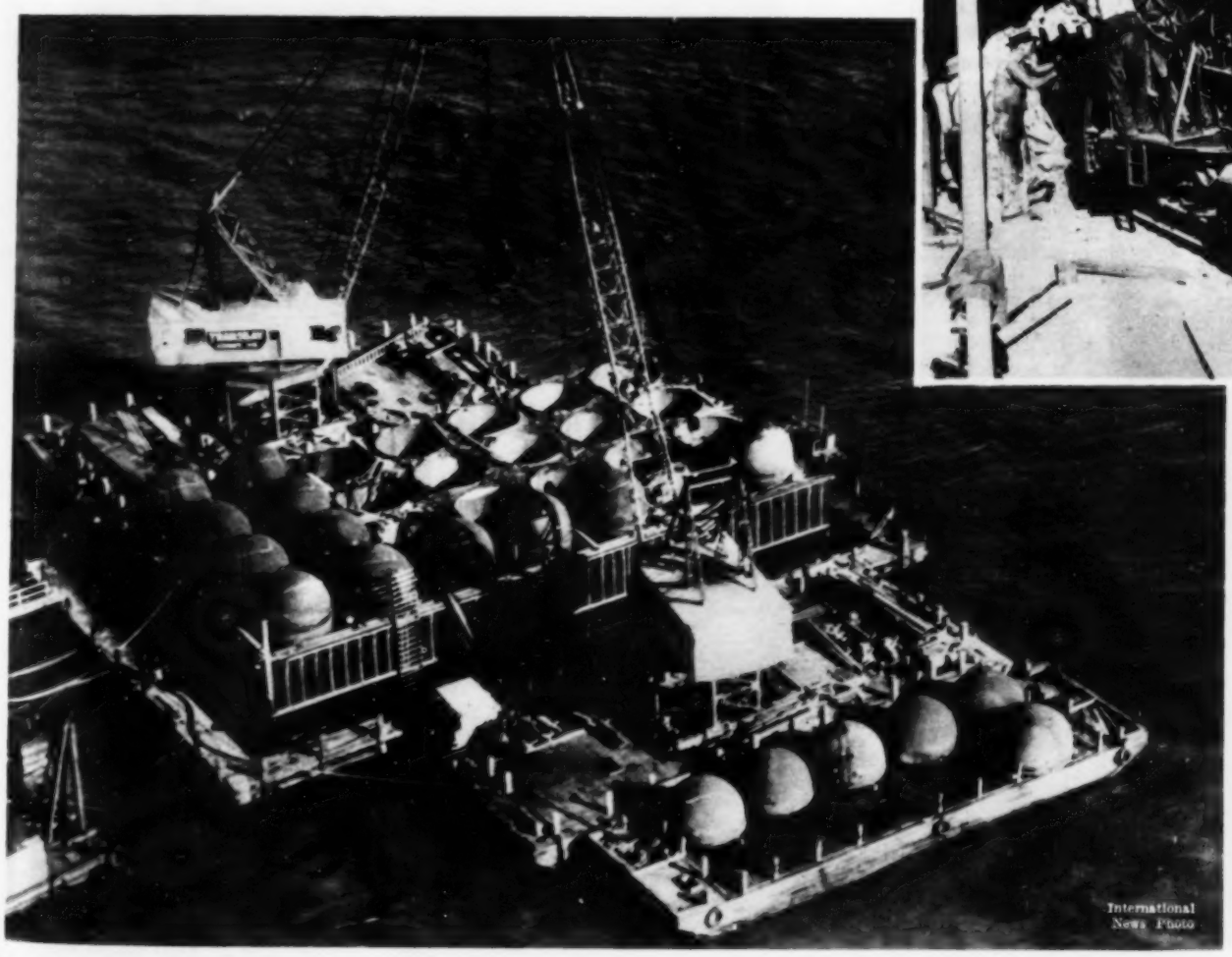
SHOULDER-WIDENING PROGRAM on 1,000 mi. of Indiana's 8,600-mi. state highway system provides employment for more than 20,000 men, decreases maintenance costs, adds to highway safety, improves appearance, and prepares right-of-way for future pavement widening. Work is financed with $600,000 PWA funds, $1,400,000 state highway funds, and recent allotment from CWA.

UNITED STATES DEPT of INTERIOR
BUREAU of RECLAMATION
BOULDER CANYON PROJECT
POURING 1000000 Cu Yd
OF CONCRETE IN DAM
7 MONTHS AFTER START of POURING
JUNE 6 1933 TO JAN 7 1934
SIX COMPANIES INC
CONTRACTORS

1,000,000 YD. IN 7 MONTHS is concrete-placing record in Boulder Dam, June 6, 1933, to Jan. 7, 1934. Resident executives gather to see millionth yard placed. *(Left to right)* CHARLES A. SHEA, construction director, Six Companies Inc.; FELIX KAHN, treasurer; WALKER R. YOUNG, construction engineer, U. S. Bureau of Reclamation; BERNARD WILLIAMS, assistant construction superintendent, Six Companies Inc.; JOHN C. PAGE, office engineer, U. S. Bureau of Reclamation; FRANK T. CROWE, general superintendent, Six Companies Inc.

MUCKING MACHINE *(below)* attacks portal of one of 29 tunnels on 239-mi. aqueduct from Colorado River being constructed by Metropolitan Water District to deliver water to Los Angeles and twelve other Southern California communities.





COMPRESSED-AIR FLOTATION CAISSON METHOD *(left)*, perfected by Daniel Moran, consulting engineer, is used in constructing five deep-water piers for two suspension spans of west-bay crossing of San Francisco-Oakland Bay bridge. Caisson for pier 6 (tower pier), 1,110 ft. west of Yerba Buena Island, is 74½ ft. by 127 ft. in plan and contains 28 steel cylinders, 15 ft. in diameter, capped with hemispherical steel domes equipped with air valves. By regulating air pressure in cylinders (which does not exceed 8 lb. per square inch) caisson can be adjusted during flotation to site and sinking to mud at depth of 110 ft. During sinking to mud bottom, domes are cut off individual cylinders while cylinders are built up in 20-ft. lifts between concrete pours. After reaching bottom, domes are removed to permit dredging through wells until caisson lands on rock at depth of 170 ft.

Bridge Floor Lightened

Aluminum

SUBSTITUTION of structural aluminum alloy for steel and wrought iron in the floor system of the Smithfield St. bridge across the Monongahela River, at Pittsburgh, Pa., reduced the dead load on the two main spans by 750 tons and extended the life of the 51-year-old structure perhaps 25 years. Complete replacement of a vehicular roadway, street railway floor system and two sidewalks was accomplished in 24 days, Oct. 5 to 29, 1933, without interruption to street-car or pedestrian traffic. Reconstruction of the existing bridge is estimated to have effected an immediate saving of nearly $1,000,000 on the cost of a new bridge, according to Charles M. Reppert, chief engineer of the city's Department of Public Works, who had charge of the remodeling.

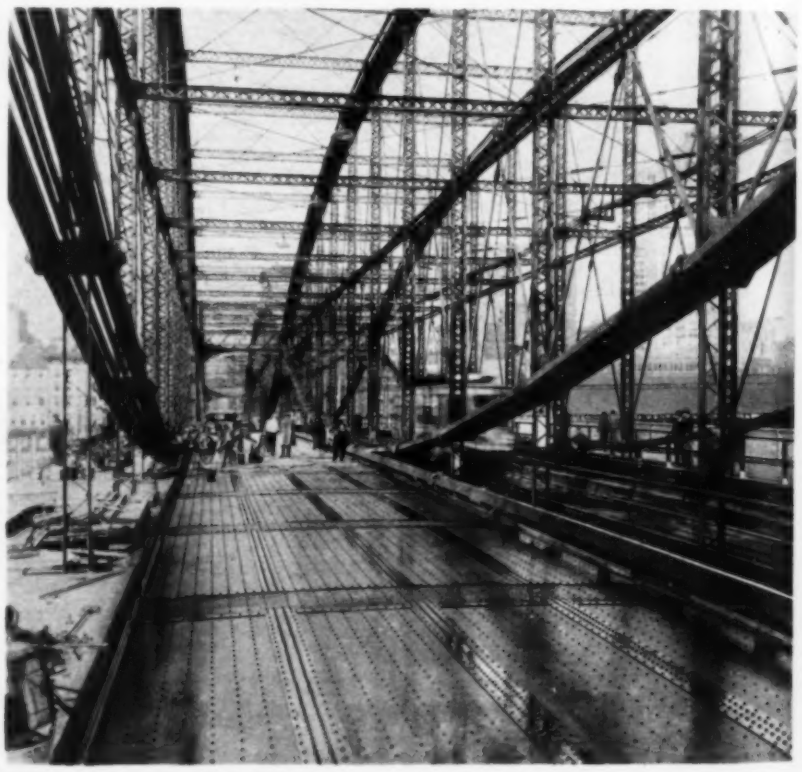
Design of Bridge—As originally designed by Gustav Lindenthal and constructed in 1882, each of the two main spans of the bridge, 360 ft. in length, was carried by two Pauli, or double-elliptical, trusses spaced 25 ft. 8 in. on centers. The original design provided for extension of the bridge upstream. Later modifications of the structure added a third Pauli truss on the upstream, or east, side of each of the two 360-ft. main spans, and provided a width of 24 ft. 8 in. between the two upstream trusses for a pair of street railway tracks, leaving the downstream roadway clear for vehicular traffic. The highway floor system consisted of wrought-iron plate-girder floor beams and six longitudinal stringers supporting a laminated timber floor 11 in. thick. On the east roadway, which carried the street railway tracks, the cross ties rested directly on four lines of stringers. Sidewalks floored with 2-in. planks were bracketed out on both sides of the bridge.

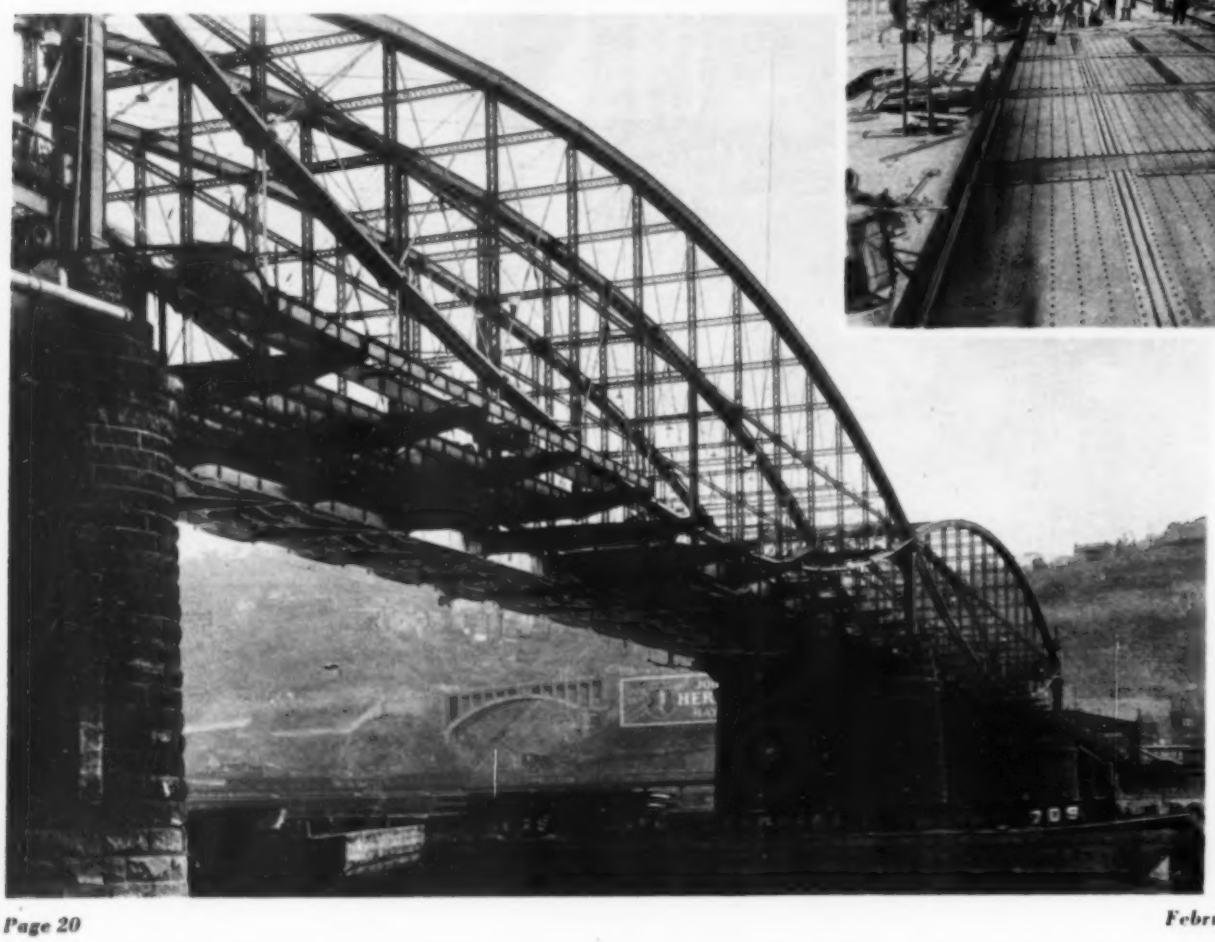
Examination of the bridge in 1932 revealed the necessity for numerous repairs to the main stringers, trusses and floor system, although the essential structure did not seem to have deteriorated unduly in its 50 years of existence. A study of alternate types of floor was undertaken, and attention was directed to structural aluminum alloy. Although structural aluminum never had been used as a major part of a bridge, the fact that this material could be obtained in shapes and plates with strength characteristics equal to those of structural steel—but at a saving of 65 per cent in weight—made possible the design by the engineers of the Aluminum Company of America of a floor system which will add probably 25 years to the life of the bridge and will greatly liberalize the live-load limitations under which bridge traffic had been operating.

Floor System — Except for the fact that more attention was given to the saving of material, because of the higher cost of aluminum, the design of the new floor was much like that of the old system which it replaced. Floor beams and stringers of the aluminum floor system are built-up plate girders with angle flanges, plus cover plates where required. Each of the two main trusses of the bridge has thirteen panels, slightly less than 28-ft. in length, with the main floor beams suspended at the panel points by U-hangers from the Pauli trusses. These floor beams, 39-in. deep in the street-car roadway and 42-in. deep under the crown of the vehicle roadway, are spliced just east of the center truss, as were the old floor beams, to facilitate erection without interrupting street-car service. The car tracks were shifted to the vehicle roadway during replacement of the railway floor system. On the street railway side, four load-carrying stringers, one under each rail, and two wind stringers, comprise the main longitudinal members.

A built-up floor system to provide a rigid roadway was provided for the vehicle side. Two 39-in. stringers support intermediate floor beams at the third points of the panel, upon which rest 7-in. channel joists, spaced 8 in. c. to c. The joist system is further stiffened by transverse 8-in. channel distributing members rigidly attached to the joists midway between adjacent floor beams.

On the joists was laid 7/16-in. tread plate covered with a 1½-in. wearing course of cold-laid asphaltic mixture. The diamond-shaped projections of the tread plate serve to prevent the surface material from creeping under traffic. Like the roadway, the sidewalks are carried by aluminum alloy framing and decking. The surface is ½-in. cold-processed asphaltic paving on a smooth ¼-in. aluminum-alloy plate. An aluminum alloy handrail on each sidewalk, employing oval and cylindrical tubing, as well as rolled shapes, adds to the attractiveness of the bridge.





ALUMINUM DECK on roadway side of Smithfield St. bridge is ready to receive asphaltic wearing surface. TWO MAIN SPANS *(left)* of bridge are carried by three Pauli trusses per span. Replacement of floor systems proceeds simultaneously on two spans. Railway floor system (on far side) has been completed. Highway floor system is being replaced.

by Replacing Steel With

Members

Contract Provisions—A contract for the reconstruction of the floor system was awarded to Walter S. Rae, of Pittsburgh, for a total price of $276,436, of which $192,000 was for about 330 tons of fabricated aluminum. A subcontract for the fabricated structural aluminum was given to the Aluminum Company of America, and fabrication was performed by the Fort Pitt Bridge Works. The contract provided that construction be carried on under a schedule limiting the diversion of vehicular traffic to a side of the bridge, spiking the rails directly to the 11-in. timber deck.

Shop Fabrication—To meet the rapid erection schedule set for this job, it was necessary that the fabricating shop prefabricate all parts in the largest possible units, maintain extreme accuracy in fabrication to eliminate delays in the field, and adhere rigidly to the delivery dates. Hot-driven steel rivets were used throughout, and welding or burning of the aluminum was prohibited, because structural aluminum is a heat-treated material which loses a large proportion of its strength if heated above its critical temperature. Standard steel equipment and methods were used in the shop, and a priming coat of shop paint consisting of iron oxide and zinc chromate pigment in a bakelite varnish vehicle was applied with brushes.

Light weight of the material was an asset in the shop work, as small pieces could be handled with little fatigue to the workmen. To prevent scoring or marring of the aluminum surface, steel cable, protected by rubber hose, was used where unprotected chains or hooks would have been employed in handling structural steel. In no case was it necessary to straighten shapes after punching. Because the coefficient of thermal expansion of aluminum is twice that of steel, a noticeable variation occurred in the length of members produced from the same wood templet at different times of the day. These variations were not great enough to cause difficulty in fitting up.

Standard steel buttonhead rivets were used, both in the shop and the field, and the best results were obtained with rivets at a bright red heat. It was demonstrated that normal shop-production speed could be maintained in driving without danger of overheating the aluminum. The rivets were $\frac{5}{8}$ in. to $\frac{7}{8}$ in. in size.

Sidewalk floor panels were shop-fabricated to final dimensions about 27½ ft. long by 8 ft. wide. The floor for the roadway also was shop-assembled and riveted into sections the length of the panels and 11 ft. wide. Two of these sections completed a panel of roadway floor, with the exception of a 4-ft. space over each floor beam, which was filled in by a field-reamed and riveted tread plate. Fabrication of the aluminum into these large units was made possible by the light weight of the material, about one-third that of steel.

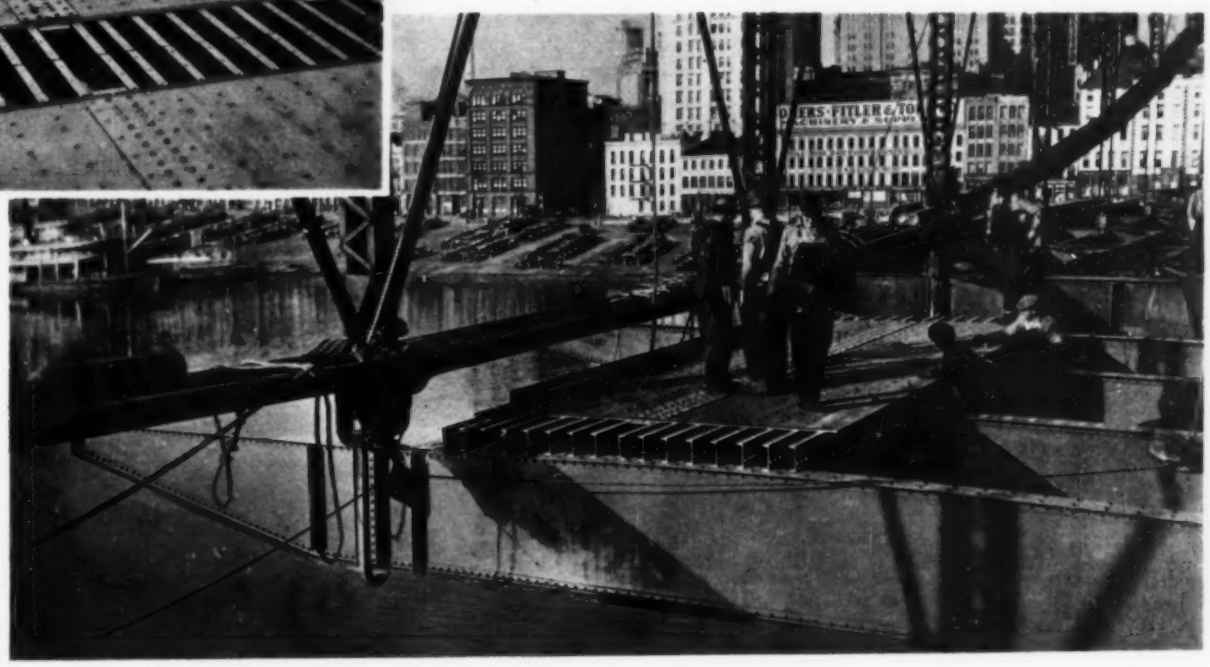
Erection Equipment—To remove the old steel and erect the new aluminum floor system, the contractor installed a hoist engine at each end of the two main spans. Heavy hoisting equipment was unnecessary, as the heaviest piece of old steel weighed only 3½ tons. The main hoisting line (⅝-in. wire rope) was dead-ended by a shackle to the top chord of one truss and was reeved through a snatch block fastened to the top of the other truss, the load was carried by a running snatch block suspended between the two trusses. An auxiliary 1¼-in. manila rope runner was provided for handling lighter pieces and for assisting with beam and deck sections. Four 220-cu.ft. compressors furnished air for the riveting gangs. Two compressors were stationed at each end of the bridge, with a 100-cu.ft. receiver at the end of each air line, adjacent to the center pier.

It was prescribed in the contract that work should be carried on simultaneously on both spans throughout the 24 hr. of each day. At night, the job was illuminated by 300-watt lights on the bottom struts of the wind bracing at the panel points, by a 1,000-watt portable floodlight on each span (used to illuminate the river and barges below), and by several portable spotlights of 100-watt capacity.

Labor Forces—In organizing his labor forces, the contractor provided an erection crew for each span for each 8-hr. shift. As the work progressed, he added fitting-up crews and riveting crews on each shift. In addition to the crews actually working on the two main spans, he kept a utility crew on each shift to do the concrete work on the three piers, to re-floor the approaches and to take care of miscellaneous items.

Riveting gangs were added on the roadway section as fast as space permitted. At the maximum, 14 gangs were operating. These gangs drove some 37,000 rivets in 4 days.

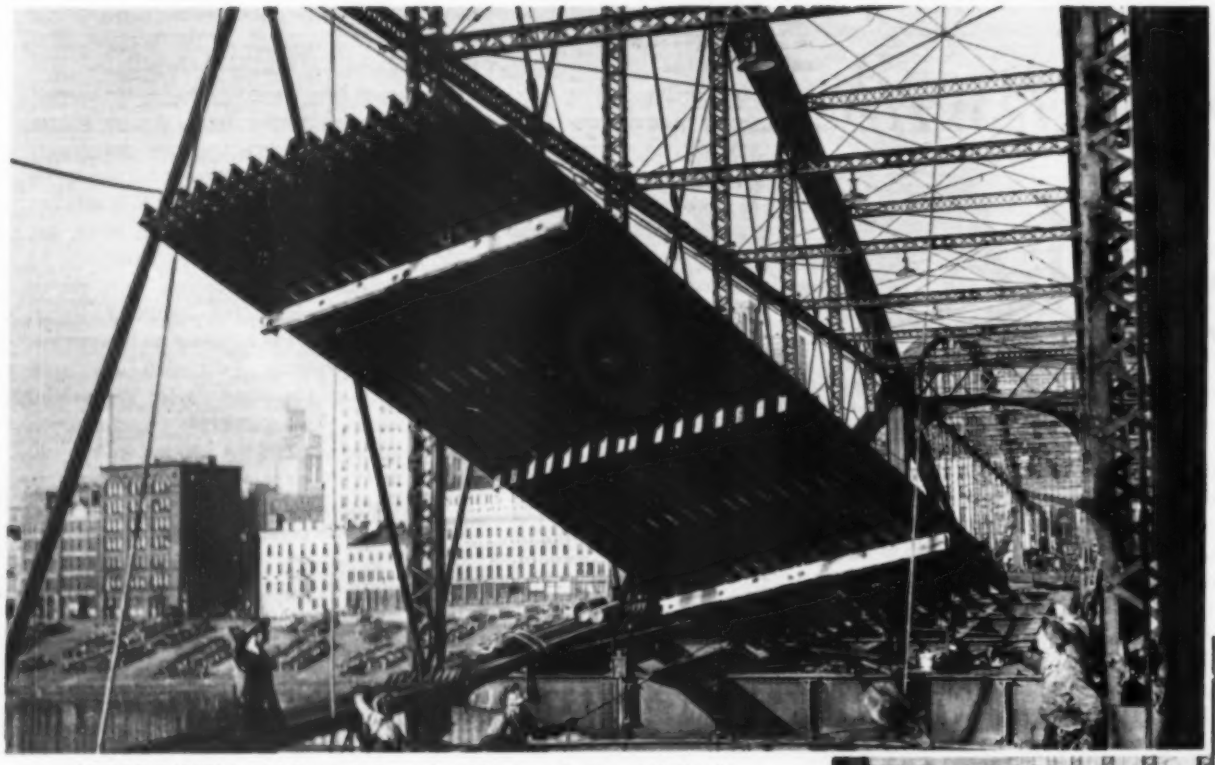
Reconstruction Procedure—Because the main spans are suspended between the center panels and the piers on hangers which afford no lateral stiffness, it was necessary that the reconstruction work commence in the center of each span and proceed toward one end. This



FOURTEEN RIVETING GANGS drive 37,000 rivets in 4 days. **SINGLE SECTION** *(right)* of highway floor, as fabricated in shop and raised from barge, stretches between two main floor beams and covers half of highway width.

period of 24 days. Pedestrian and street-car traffic had to be maintained throughout this period.

To carry out this provision, the east, or upstream, side of the bridge was reconstructed first. On the night of Oct. 5, the bridge was closed to vehicular traffic, and the Pittsburgh Railways Co. began laying track on the roadway



FLOOR PANEL for highway deck, 11 ft. wide by 27 ft. long, is hoisted from barge to be placed on main and intermediate floor beams.

condition made it impractical to deliver material by truck, and a system of barge transportation was developed both to deliver the structural aluminum and to remove the scrap steel.

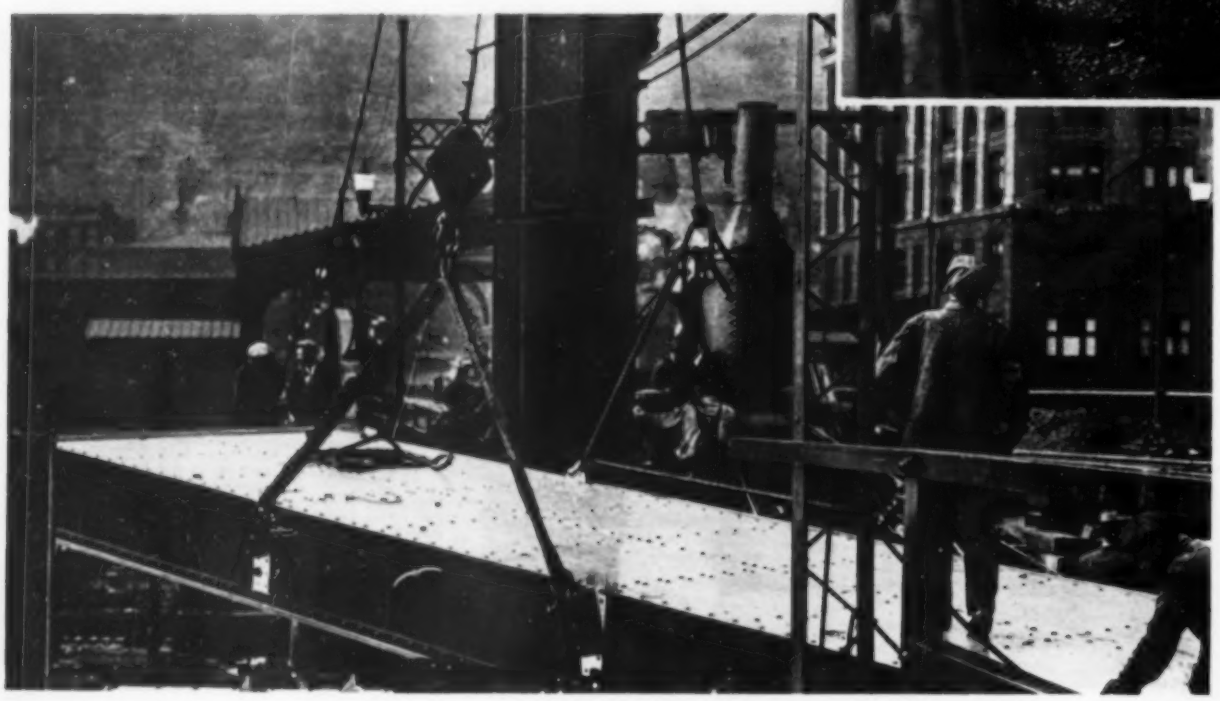
After the street railway traffic had been diverted to the new tracks on the roadway side of the bridge, the rail ties were removed from the upstream roadway, and the contractor dropped all the stringers between panel points 5 and 8 on the railway side, followed by the upstream half of the floor beam at panel point 6, to an empty barge below each span. The structural aluminum floor beam for panel point 6 then was raised into position and temporarily supported by a shop-bolted steel shelf-angle at one end and by the new permanent U-bolt connection to the east truss at the other end. The floor beam at panel point 7 then was raised, and the new aluminum stringers were filled in between the two panel points.

As the next step, the erectors lowered the stringers between panel points 8 and 9 and followd them with the floor beam at panel point 8. The new aluminum floor beam was raised and the stringers filled in between floor beams 7 and 8, and this procedure was continued to the end of the truss. After the aluminum members had been erected from the center of each span to the center pier, the rigging was moved back to panel point 5, the stringers between panel points 4 and 5 were lowered, and the floor beam at panel point 5 was raised. The procedure for the remainder of the span was similar to the first half of the operation.

As soon as the floor beams and stringers had been erected from the center panel to the middle pier, new gangs were employed to fill in the top and bottom laterals and struts and to ream and rivet them. After three or four panels had been completed, the railway company began relaying ties. While the riveting of the floor system on the street-car roadway was being completed, the contractor erected and riveted the sidewalk sections adjacent to the east truss and laid the ½-in. cold asphaltic surfacing. This half of the bridge then was opened to street-car and pedestrian traffic, its complete rebuilding having required only 9 days.

On the highway side, difficulty was

SHOP-FABRICATED SECTION *(below)* of bridge sidewalk is placed in position.



COLD-LAID ASPHALTIC SURFACING 1½ in. thick is placed and rolled on aluminum deck of highway side.

experienced in breaking up the heavy timber decking, which consisted of one 5-in. and two 3-in. layers of planks. Before one of the old floor beams could be removed on this side of the bridge, it was necessary to support temporarily the corresponding floor beam on the other side, because the splice was made to the east of the center truss hanger. To provide this support, a steel king-post truss, two panels long, was set up as shown by one of the photographs. This truss carried the floor beam in a stirrup.

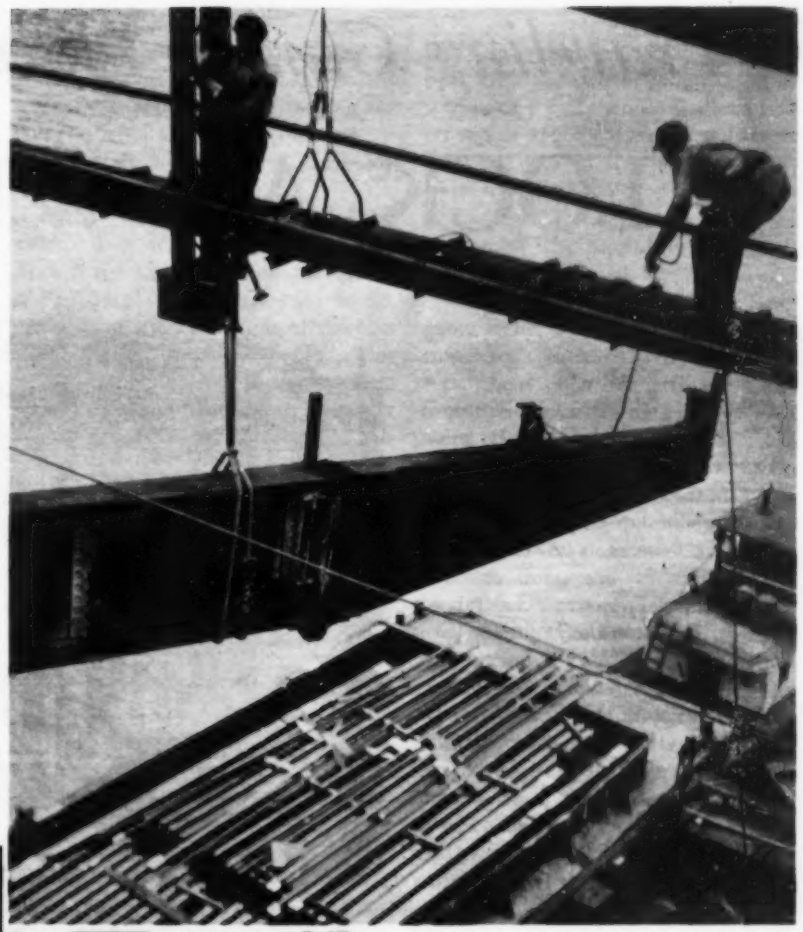
Work on the roadway floor started at panel point 6 of each span and proceeded toward the middle pier. With

the railway half of the floor beam supported by the king-post truss, which spanned from panel point 5 to 7, the roadway half of the floor beam was lowered to the scrap barge. The shop-bolted shelf angles then were removed from the inner end of the railway floor beam, and the highway half of the floor beam was raised from the barge and secured to the permanent U-links on the center and west trusses of the bridge. A web splice then was made between the two halves of the floor beam, care being taken to see that the bottom flanges were in contact to insure continuity. All holes in this web splice were reamed from 11/16 to 15/16 in., and the rivets were driven prior to moving the king-post truss to the next panel point.

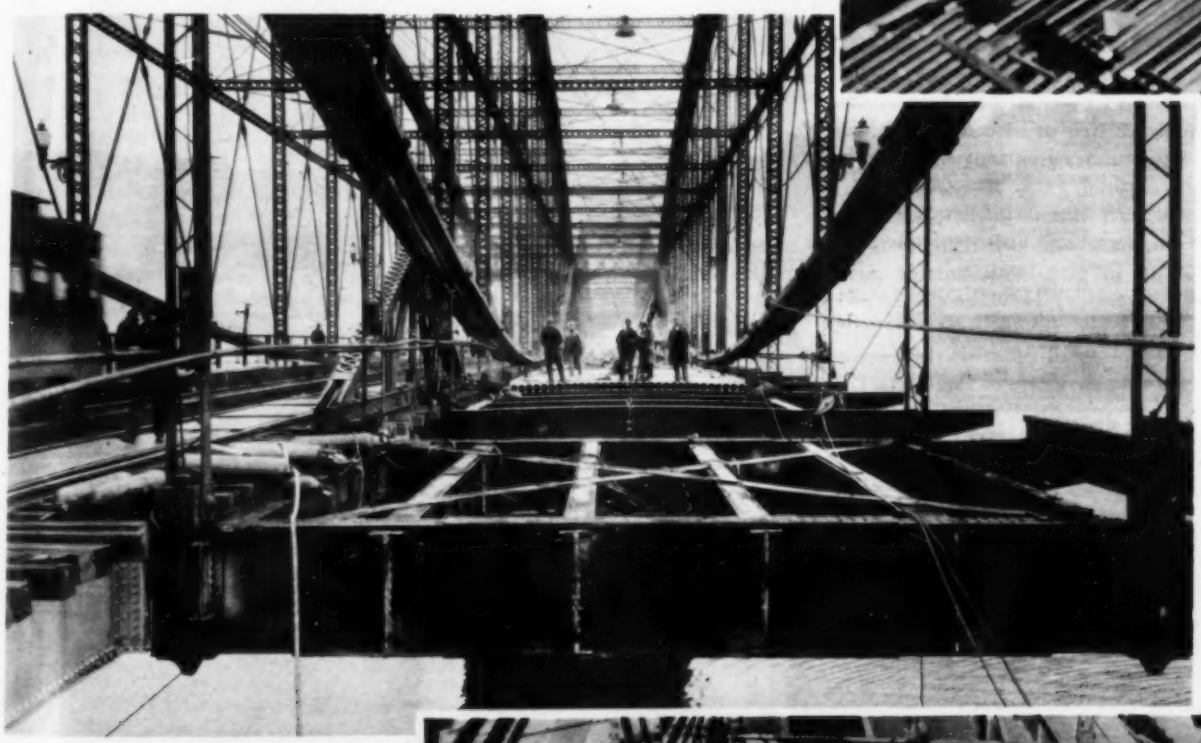
While the web splice was being reamed and riveted, the erection crew raised the longitudinal girders, intermediate floor beams and deck panels. When two complete panels of floor had been erected, reamers and riveters started on the stringer and floor beam connections and roadway section splices. oak planks. The 1½-in. surfacing of cold-mixed asphalt was placed on the roadway on Oct. 29, and the next day the roadway half of the bridge was opened to traffic—just 24 days after the closing. All structural members received two field coats of aluminum paint.

In erecting the structural aluminum, it was found that unsound rivets could not be cut out satisfactorily with a rivet buster, but that it was necessary to drill holes through the heads approximately the diameter of the rivets, knock off the heads with cape chisels and then back out the rivets. Reaming required only the lightest air tools on the market. Whenever it was necessary to cope a structural aluminum member, or to cut it for a field adjustment, it was found that long cuts could be made successfully with a ten-tooth carpenter's saw and that minor coping could be accomplished by nicking the aluminum along the desired line with a cape chisel and then breaking it off.

Administration — Reconstruction of the Smithfield St. bridge was carried out under the direction of Edward G. Lang, director of the department of public works. Information contained in these notes was obtained from reports made by Charles M. Reppert, chief engineer; by Henry D. Johnson, Jr., construction engineer for bridges; and by C. G. Schade, chief engineer and works manager of the Fort Pitt Bridge Works. Ross M. Riegel was division engineer of bridges of the department of public works. J. P. Growdon was in charge for the Aluminum Company of America. The general contract was executed by Walter S. Rae, of Pittsburgh.

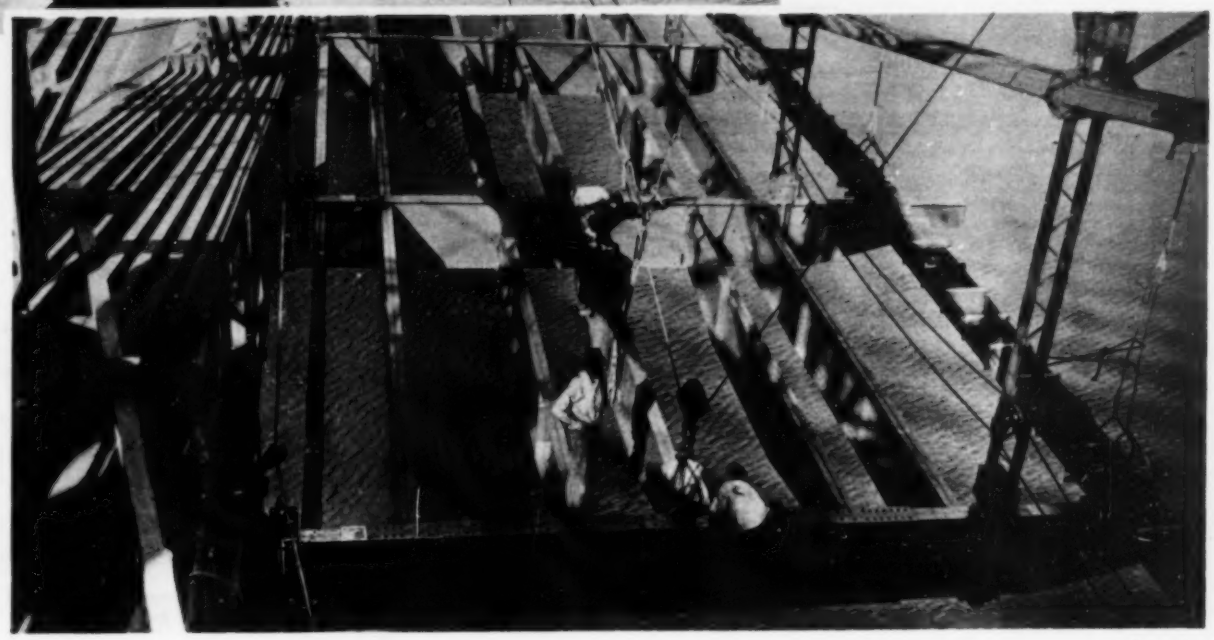


WROUGHT-IRON FLOOR BEAM of old floor system is removed and lowered to barge. New aluminum floor beams can be seen in adjacent barge.



KING-POST TRUSS (to be seen alongside middle truss of bridge) supports one end of floor beam on street railway side while second half of old beam is removed and replaced on highway side.

As soon as the last panel of roadway floor had been placed, the contractor removed his hoisting engines and rigging. While the curb guards, scuppers and minor members were being field-bolted, a derrick boat placed the west sidewalk panels. Simultaneously, the riveting was being completed on the roadway half of the bridge, and the approach spans were being re-decked with 8x10-in. sleepers and 4x12-in. white



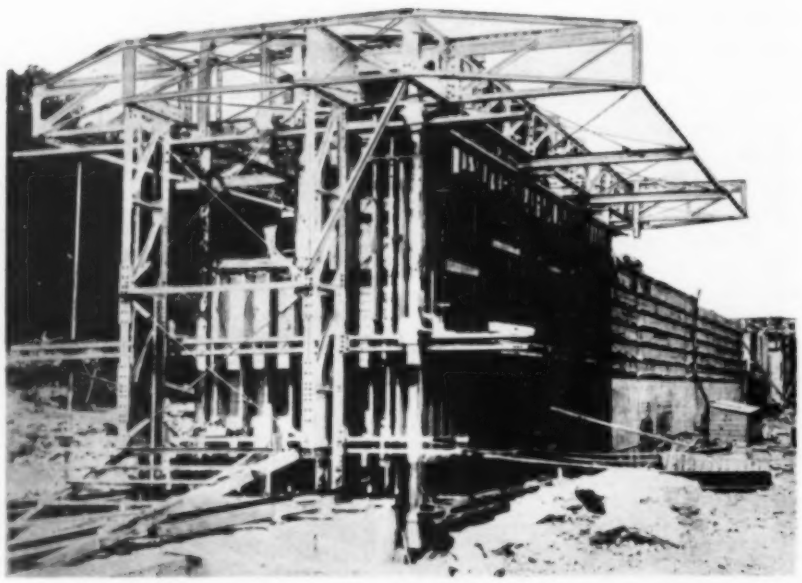
ALUMINUM-ALLOY BEAMS AND STRINGERS are carried by U-hangers from trusses on street railway side of bridge.

Traveling Gantry Places Concrete for Tennessee

LOCK AT WHEELER DAM

ONE OF THE important projects started under the provisions of the Emergency Relief and Construction Act of 1932 for aiding the unemployed by means of river and harbor works is the lock under construction at the site of Dam No. 3 (now known as General Joe Wheeler Dam) on the Tennessee River 15 mi. upstream from Wilson Dam at Muscle Shoals, Ala. The project begun in January, 1933, by Stevens Bros. & the Miller-Hutchinson Co., of New Orleans, involves 30,000 yd. of rock excavation and 70,000 yd. of concrete.

Combination of extensive construction equipment specially suited for work of this type and the contractors' long experience on the Mississippi River and its tributaries has had much to do with the progress made. In fact, most of the plant on the job was towed from similar work on the Illinois River. All the work is being handled in the dry behind a sheet-pile cofferdam. A tight limestone formation underlying the site, together with a good coffer, has practically eliminated seepage. Pumping has been limited largely to rainfall in excess of evaporation.

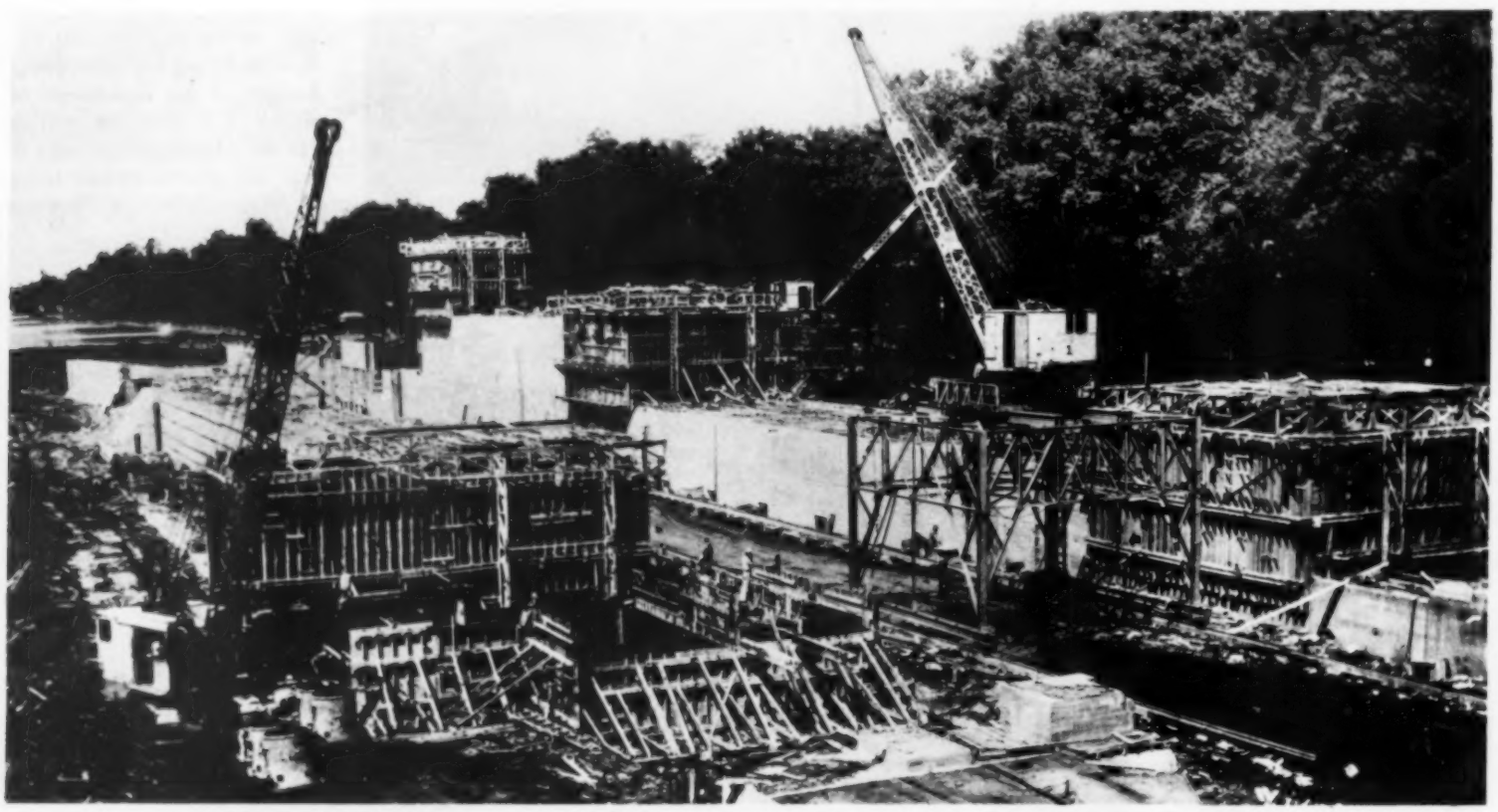


WALL FORMS in 50-ft. section are carried by structural steel frame on wheels.

Design—Standards adopted for a 9-ft. navigation stage on the Tennessee are being followed in the construction of this lock. The lock chamber is 60x360 ft. in plan, with suitable guard walls at both ends. When the decision was made to provide a 9-ft. stage on the Tennessee River from the Ohio to Knoxville, the Corps of Engineers, U.S. Army, selected the site where the work on this lock is under way. At that time a 15-ft. lift was contemplated. Later, requirements were changed and the height for which the contract was let provided for a dam and lock having a 39-ft. lift.

When the Tennessee Valley Authority was created last year it was thought advisable to modify the design of the lock to permit a still higher dam to be built at this site, in case such procedure should appear desirable in the future. Work is going ahead rapidly on the lock, with all features of the latter being built to permit an increase in height, if desired.

Construction Plan—As soon as the contractors completed the cofferdam it was easily unwatered and excavation of the rock necessary to prepare the foundations was started. Meanwhile, the concrete mixing plant for the job, containing three 1-yd. Smith tilting mixers, was set up against the inside of the outer leg of the coffer, toward its upstream end. The plan of operations was to start placing concrete in both lock walls as soon as enough rock had been removed to permit pouring to begin. After that, removal of spoil from the excavation and concreting were carried along simultaneously without interference. This was accomplished by installing a traveling gantry that spanned the space between the walls. A whirley crane on this gantry is worked in combination with two crawler cranes traveling on the rock bottom, one on the



WITHIN COFFERDAM of steel sheetpiling construction of 60x360-ft. lock chamber and guard walls is carried on in the dry. Whirley crane on gantry handles concrete to forms.

outside of each wall. The propelling mechanism on the gantry is chain-driven from the power plant of the whirley on the latter, the whirley operator being the only man on the gantry.

Spoil from the excavation was dug and loaded into heavy dump-body trucks by crawler-mounted shovels and cranes. It was wasted in a spoil bank on the offshore side of the upper end of the coffer. Runways were kept open through the job for the trucks handling the spoil, the gantry permitting a wide, unobstructed roadway between the walls.

Concreting — Concrete is delivered from the mixing plant to the point where pouring operations are in progress in bottom-dump buckets handled in sets of three on motor trucks. The latter deliver to the whirley crane on the gantry and to the cranes operating along the outside of the walls. Pouring of a section of wall may thus proceed from both sides simultaneously. The spoil trucks used the same roadways as those handling concrete as long as work on the excavation was under way.

The sand and gravel used in the concrete are dug from the river and delivered to the mixing plant in barges. The latter are unloaded into Blaw-Knox bins over the mixers by means of a floating derrick. Cement for the job comes from the Cape Girardeau plant of the Marquette Cement Co. on the Mississippi River in Missouri. It is delivered to the project in bulk in barges each holding about eight cars. The route is down the Mississippi to the Ohio, up the latter to the Tennessee and thence on that river to the site, a distance of about 350 mi.

At the mixing plant the cement is pumped from the barges moored alongside the coffer to batchers by Fuller-Kinyon outfits. Although the maximum distance of delivery is about 250 ft. and the lift as much as 35 ft., no difficulty is experienced in moving the bulk cement. Only three men are required in the barge to watch the pump and do some cleaning up.

Forms—Movable wall forms for this project were designed and built by the Blaw-Knox Co. Each section consists essentially of a structural steel frame, 30 ft. long and the height of the lifts in which the concrete is poured. This frame is mounted on a pair of long legs at one end and a pair of short legs at the other end. Each pair of legs carries double-flanged wheels running on wide-gage track. Wooden side forms lined with Presdwood are swung from this traveling steel frame.

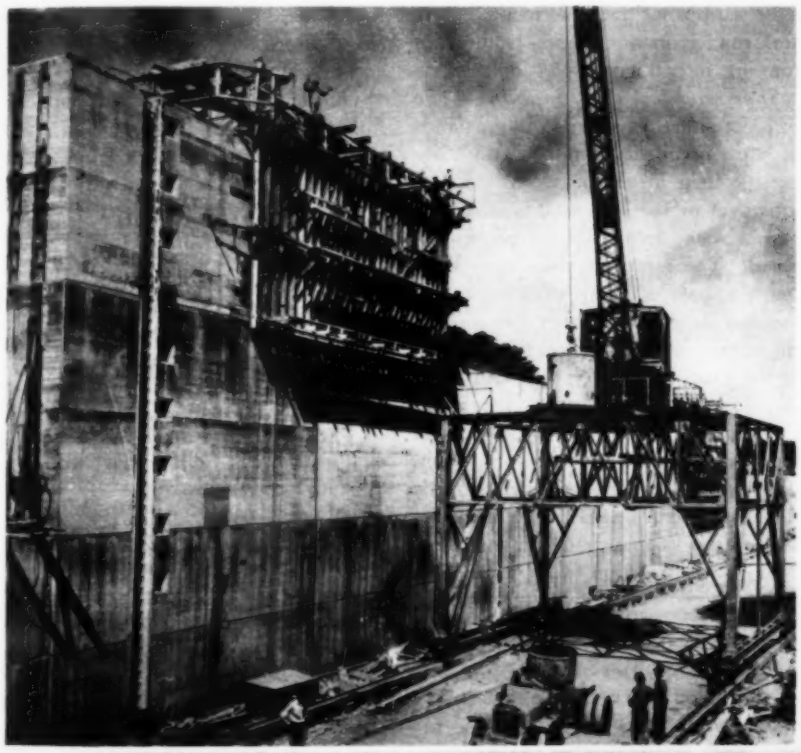
With a section of the forms spotted at the point desired, the end legs are blocked in place so they cannot move lengthwise of the wall. The side forms are then brought to line and grade by adjustments on the steel frame. Heavy cross bolts between the side forms anchor the side forms accurately in the determined position.

When a section of forms is to be moved the cross bolts are removed, the end blocking of the legs is pulled and the forms are slacked off to clear the concrete. A fall line on one of the cranes is then used to pull the section along to the next position.

The walls are being built in three lifts of about 15 ft. each. As soon as one lift is poured the length of the wall, the forms are jacked up to the next lift. The pair of long legs of the section of forms then travels on a track on top of the completed first lift. For the first pour at the new height the short legs are shored up from the top of the first lift. After that they travel on top of the second lift as in the beginning.

Under the requirements of the Emergency Relief and Construction Act the contractor's forces may be worked on 6-hr. shifts only. Most of the operations are conducted on a 24-hr. basis. Since about 65 men are required to a shift, the contractor would have had to provide facilities for about 350 men, had a construction camp been located at the job. At the same time, it was desirable to furnish work for resident local labor to the fullest possible extent. This combination of conditions was met by eliminating any camp on the work. Motor buses running between the job and Florence, Ala., a distance of about 20 mi., are operated by the contractor without expense to the employees. Since one shift comes off as the next one goes on, the buses run full in both directions. Stops to pick up and discharge employees are made going and coming at any place along the route. This scheme has been satisfactory for all concerned.

The improvement of the Tennessee River has been under the direction of the Chief of Engineers, U.S. Army, with Major R. R. Neyland, in general charge and Capt. H. D. W. Riley, military assistant in direct charge of construction. G. P. Fleetwood is resident engineer.



TRAVELING GANTRY *(left)* **carrying whirley crane picks up concrete buckets from light trucks and swings them to point of discharge over wall forms.**

ROCK EXCAVATION for lock foundation totalled 30,000 cu.yd. Ledge formation is broached and channeled for footings of wall structure.

Helps to Successful Contracting

XVI . . . Accident Prevention

Sixteenth of a series of articles on applying business principles to construction and making profits by avoiding costly mistakes

By HARRY O. LOCHER
Contractor, New York

IN A DISCUSSION about accident prevention, a well known superintendent was asked to give his ideas. "When you see a man doing a careless or thoughtless thing or having a close call, give him hell and let as many others hear you as you can," he told them. "A great many men do not think," he went on. "Some of them will stumble right over a Safety First sign and get into trouble, but if a superintendent or foreman will hop all over 'em and make it plain to them what little use they have made of their heads, such men are very likely to profit by what you tell them. You have to keep preaching safety to such fellows, all the time."

Penalties of Carelessness—What this superintendent said is true. Some men have to be constantly jogged to make them look out for themselves. Some of this type are good workers, but when it is discovered that they do not know how to take care of themselves they should be put in places of as little risk as possible. A most conscientious worker and a fine rigger had two serious accidents, one right after the other, the second one causing him the loss of his right hand. There was no excuse for either accident; they were due to thoughtlessness. In the first instance, in reaching over to screw down a grease cup, he leaned too close to the disk on the shaft of a big hoist and was struck on the head and shoulder by the crank pin. The second accident was even more careless; he stuck his hand between the flange of a big sheave and the cable which passed over it to pour oil in the bearing boxes. Not knowing he was on the tower, the operator started his machine and this man's hand was cut off at the wrist as the cable mashed it against the face of the sheave. He fell backward from the shock, instinctively throwing his arm over a guy line and sliding to the ground from the top of the 100-ft. tower. He lived, but he was badly burned from the slide, and his right hand was gone.

"The accident situation is largely in the hands of superintendents, foremen and other outside men in authority. Any superintendent or foreman who is making a bad accident record should be investigated."

Two things would have prevented this bad accident. The first, of course, would have been carefulness; he should have reached *over* the line, not between it and the sheave. The second thing, too, would have been carefulness; had he stepped to the other side of the tower he could have done his oiling without reaching either under or over the line. Carelessness, anyway you put it. Most accidents are the results of carelessness—either carelessness in making dangerous places safe, or carelessness of men in looking out for themselves. It was carelessness in not having the top of this tower well fenced for safety.

A cracking good tunnel superintendent was telling about a certain tunnel he had been in. "When I first hit the job," he said, "the heading gang scared me stiff when they went back to do some reloading. They were about to shove some dynamite into an almost red hot hole. But they didn't do it and, believe me, they never tried it again. That stunt is bad medicine. You can never tell when she'll turn loose on you. A hot hole and a cap just don't belong together."

"Another thing," he continued, "that makes the men feel easy and saves you a lot of worry: I don't let any of my men go back in the heading until it is scaled to suit me—I mean *me*. Half of these fellows don't know when a roof is properly scaled. Some of them might work an hour or more trying to bring down something that is as solid as Gibraltar and overlook something that might drop any minute. There is a sort of knack to scaling. Good tunnel men get the feel of just what is loose and dangerous. I keep two good scalers at it every Sunday. They go over the whole roof. Then, everybody feels safe and can attend to his work, and not go about like a turkey in a trap—head up in the air most of time. Make them feel easy; then they can hit the ball."

"Good tunnel men get the feel of just what is loose and dangerous."

It is worth noting that the contractors' men engaged on rock scaling and tunneling operations at Boulder Dam and other large projects are provided with "hard-boiled" hats of stiff fibre construction to protect their heads from injury by falling fragments of rock.

After many years of experience and witnessing hundreds of accidents, from mashed hands and feet to men being badly maimed and killed, I am very deliberate in saying that I believe that at least 95 per cent of all accidents I have known of were due to carelessness—carelessness in safety measures and equipment or carelessness of men in looking out for themselves. Both of these things require thought and study. Besides the social misfortune and the tragedy that follow in the wake of most serious or fatal accidents, there are, too, economic losses, sometimes running into thousands of dollars.

Superintendent's Responsibility—The accident situation is largely in the hands of superintendents, foremen and other outside men in authority. Any superintendent or foreman who is making a bad accident record should be investigated. The safety of their men is as much a part of their work as is the number of car-loads they can put in the dump, the tons of steel they can set, or the yards of concrete they can pour. Accidents are costs—costs that sometimes make a job show a loss. Insurance is not always complete protection, either when carried by a company or by the contractor himself. And there are lots of shocks that money cannot heal. Making construction work as safe as possible is the best method of preventing accidents. As stated before, superintendents, foremen and mechanical men are the ones most responsible for safety measures; they should do the thinking and looking ahead.

"'I consider it a black mark against me when one of my men gets hurt,' said a foreman."

Making a Trestle Safe—On a hydraulic fill dam the material was sluiced to the site through wood flumes built on trestles. This trestle and flume timber was sawed locally and was not first-class material. In spite of careful inspection a bad stringer would sometimes give way when the flume became clogged and cause the failure of from one to several 12-ft. sections of trestle and flume. Several men were injured by these accidents. In topping out the dam it became necessary to build a double-deck trestle 80 ft. high, with the 3x3-ft. foot flume on top of it. It was a shaky looking structure. The flume tenders did not relish working up there; they could not be blamed. If they happened to be on a section that went down there was not one chance in a thousand of their escaping fatal injury. They were inclined to hang back towards the ends of the trestle, where they were safe. This increased the possibility of the flume clogging, as the men were not strung along as they should be in order to break up clogs before they overloaded the flume and became dangerous.

One day the superintendent heard one flume tender say to another, "If I knew this old running board would stay up, even if the trestle did go down, I wouldn't feel so skittish up here." This remark gave birth to the idea of installing two ¾-in. cables between high bents at each end of the trestle to support the top cross-braces of the flume and the running board and hand rail which they carried. This device gave the men a feeling of complete safety; they attended to their work properly and there were no clogs or breaks.

"Because an individual contract job is temporary is no reason whatever for not properly protecting workers. A man killed on a contract job is just as dead as one killed in a steel mill — and his wife and kids will miss him just as much."

Tunnel Precautions—Dangerous places simply must be made as safe as possible—to protect thoughtless men, and to protect thoughtful men who know they are in a dangerous place and cannot give full attention to what they are doing on this account. The timber lining was being removed from a tunnel which was to be relined with concrete. The wall plates were sawed at certain places and several sections of segments and lagging pulled down with a cable from a hoisting engine set several hundred feet back. One day a bad cave-in followed the falling timber, killing two men and almost blocking the tunnel to the normal roof. This was serious, as the work was supposed not to interfere unduly with traffic. The track had to be cleared as quickly as possible. A desultory falling of rock

continued. The men were afraid to work under it. Finally, two bulkheads of 12x12-in. timbers were built across two flat cars, back about 8 ft. from the front end of the cars and about 16 ft. apart. On top of these were laid 12x12-in. timbers 30-ft. long, projecting over the front end of the cars 6 or 7 ft. The men worked under this projection without fear, loading the stone on to the end of the car. When one was loaded it was quickly pulled out and the other one shoved in. The fall was speedily cleaned up, with no one hurt.

Some think, on account of the temporary nature of a contract job, that any old safety measures, or none at all, may be all right. They are all wrong!

"There is a strange quirk in some men—they have an irresistible urge to 'take a chance'. The trait is sometimes found in the most capable men."

When a contractor is doing work continuously his business can be considered as permanent as any permanently located industrial business, and his safety measures and policies should be no different. A man killed on a contract job is just as dead as one killed in a steel mill—and his wife and kids will miss him just as much. Because an individual contract job is temporary is no reason whatsoever for not properly protecting workers. Not to do so adds to social misfortune and runs costs up all the way from slight figures to sometimes ruinous amounts.

A contractor's loaded truck stalled on a railroad crossing, derailed a locomotive and part of a train. Two men were killed and large property damage resulted. The contractor was ruined. Why did this happen? Through carelessness and thoughtlessness. Where? Everywhere. The truck was overloaded. It had been sent out that morning with a motor not running smoothly. The driver knew the crossing was a dangerous one and that trains passed frequently, yet he limped up to the crossing with a sputtering motor and a big overload. No prudence had been shown anywhere, from the time the truck had left the yard until it was demolished. Such is the history of many accidents—no prudence anywhere!

Superintendents and foremen must constantly keep after men to keep in the clear, to use their heads. And they must constantly seek ways to throw about them as many protective measures as they can.

Taking foolish chances causes many entirely unnecessary accidents. Nothing was ever more true than that "haste makes waste." A locomotive crane was being moved across a canal on a temporary low fill. There was about 8 ft. of water on each side of it. Three 20-in. dredge pipes, buried about 3 ft., passed through the fill. Rails were spiked to timbers and overlapped them a foot or so at the forward end to make the joint. Before moving up, the joints were made secure with fish-plates with a bolt in each rail. When nearly at the center of the fill and ready to make a move, a fish-plate bolt rolled down the bank into the water. It happened that there were no extra ones on the machine at the moment, (Detail!). "We'll take a chance," said the foreman to the runner, "try her." He did. When the front truck hit the joint with a bolt on only one side of it, instead of going over the joint it shoved this rail and timber ahead and out of place. The truck dropped down into the soft fill and on down through the dredge pipes. In about thirty seconds the crane was lying on its side in the mud and water, half out of sight—all on account of not having one ¾x3½-in. bolt. In too much of a hurry—it costs money almost every time.

"Accidents are costs—costs that sometimes make a job show a loss."

A 2-yd. railroad-type shovel had been rigged up as a dragline, with a 60-ft. boom, to do some bank sloping on a canal job; the work track ran along the canal. On windy days it was difficult to keep the boom from whipping around; the swinging mechanism was not designed for 60-ft. booms. If the jacks were set there was no particular danger if the boom did get away. Ordinarily, when moving with the jacks up, the bucket was left on the ground as a safety measure until the move was completed and the jacks reset.

One morning, of all mornings, the shovel had to be moved across a 60-ft. trestle about 12 ft. high which crossed a stream that flowed into the canal. A stiff wind was blowing against the front of the machine. The last move had placed the shovel fully on the trestle. When ready to move back, instead of leaving the bucket on the ground straight out in front, and paying out the drag and hoist lines and keeping the hoist line taut, the operator picked up the bucket and started to move. With the jacks up and the bucket in the air, a gust of wind hit the boom; the operator couldn't hold it; he lost his head and forgot to drop the bucket. In a few seconds the boom had swung around far enough to upset the shovel into the creek below, badly damaging it and seriously injuring and scalding the operator. For some unknown reason he "took a chance" and lost!

There is a strange quirk in some men—they have an urge to "take a chance". The trait is sometimes found in the most capable men. Too often it causes serious or fatal accidents, and costs somebody a lot of money. These boys who take a chance on losing weeks and months and thousands of dollars, by trying to save a few minutes, a few hours and a few dollars, should be stepped on. The odds are all against them—if they win, it isn't much; if they lose, it may be calamitous. There is no sense in such a game.

Orderliness — Orderliness on work goes a long way towards keeping down accidents. Timber was being unloaded from a work train along the main line, to be used on some work for the railroad. Everybody was in a hurry and the timber was shoved off any old way to get rid of it quickly; as long as it cleared the train it was left where it fell. One morning, after several cars had been unloaded and pulled out, the foreman was standing on the pile trying to make a record of it. A through train passed and the end of a wide car struck a projecting 12x12. In a flash the foreman was in the midst of a moving, twisting pile of heavy timbers. He was maimed for life. Either a little orderliness and care in piling this timber or a little care in keeping it back out of the way would have prevented this accident.

Again, it is a safe statement that thoughtlessness is the cause of most accidents. Six-yard skips, loaded with stone, were being unloaded from railroad cars by a cableway which passed over the track. A foreman, a bright and usually alert man, stood between the skip to be hoisted and the one next to it. He failed to notice that the hooked up skip was not plumb with the cableway carriage overhead. He gave the signal to hoist. As the heavy skip cleared the floor of the car it swung plumb and mashed the foreman against the adjoining skip, fatally injuring him.

Another clear-headed foreman instructed several men to put a long heavy chain around a 3 yd. stone, to be hoisted out of the excavation. When the big stone was 4 or 5 ft. in the air the chain slipped off and the 20-lb. hook, like the cracker on the end of a whip, struck the foreman on the head, killing him instantly. He should have stood back several feet farther than the chain was long. It had often slipped off before.

As thoughtlessness causes most accidents, men should be taught to think. And, too, alert, clear-headed men should think for those under them. Some men have the "feel" of danger; some have not. There are many men who seem always to step into trouble, rather than away from it. The way should be made as safe as possible for them in both directions. Often, in trying to save a few minutes and a few dollars, the seeds are planted for heavy costs and serious or fatal accidents. It should be remembered that men react differently and that certain men are not fit for certain places. "Put him somewhere else," a tunnel foreman told a superintendent, referring to an apparently ill-fated man. "I can't spend all my time keeping that fellow from killing himself." He was put on top and got along in fine shape.

"I consider it a black mark against me when one of my men gets hurt," this same foreman said. Here really is the crux of the accident situation. When the men in charge of other men and responsible for their welfare consider an accident as a reflection upon them, unless they are entirely blameless, you have as nearly an accident proof job as it is possible to have. Thoughtful men must provide safety measures for and look out for men who are less thoughtful, or who cannot be all the time thinking about their safety. Make them feel safe; first, it is laudable humaneness; and, second, it is a good investment.

NEXT MONTH — The seventeenth and concluding installment of Harry O. Locher's series of articles on "Helps to Successful Contracting" will appear in the March issue.

Discussion of Mr. Locher's Article on "Bidding Methods"

SIR: You stated that you would like to have opinions on bidding methods on construction work, as discussed by Harry O. Locher, in your November issue. It is easier to criticize present methods than it is to devise a system for correcting them. We are writing from the standpoint of subcontractors, but the remarks can apply to general contracting as well.

From the standpoint of the contractor, general or separate, work ought to be handled on a day's-work-commission or fixed-fee basis. But from the standpoint of the owner that is not at all satisfactory. In the first place he wants to know beforehand what the job is going to cost. And in the second place, he does not want to have to do a lot of bookkeeping during construction.

It is certainly the height of absurdity to require a responsible, capable roofing contractor to figure against all of the incompetent chiselers and be able to secure any business. And when the roofing and sheet-metal contractor has to figure through a general contractor it is almost impossible to secure proper consideration for the higher figure which he must submit if he is to deliver durability and value to the owner. Few contractors, very few indeed, will limit their consideration to the bids of high class, responsible and competent roofing and sheet-metal contractors. In fact, a large proportion of the general contractors will consider bids from the chiselers and use those prices to beat down the competent contractor.

The average owner is not a great deal better, for while he knows that he will benefit by paying a better price for

a better job, he falls back on the plea that the low bidder will have to follow the specifications. Any one who has had experience in building knows how ridiculous this is. No architect can watch all the details on a job nor all of the different workmen. The result is that it is possible for the chiselers to get away with almost anything as long as they leave the job looking as though it were all right.

For many branches of the work this is not so bad, but for the most important work on the job, the roofing, it is a serious matter. Upon the skill and care which is taken with the roofing depends the durability of it and the protection of the building itself. A very large percentage of buildings, especially important buildings of large size, are being slowly but surely damaged by defects in roofing and sheet-metal work which could easily have been avoided if the owner had shown sufficiently good business judgment to have the contracts for this work placed on the basis of quality and value rather than on the basis of price.

The matter of selling building on the low bid is largely due to the failure of building contractors to "sell" the owner on durability and value, rather than on price. For a century or more building contractors have spent the greater part of their efforts in getting prices down as low as possible instead of trying to educate owners to use their business judgment in buying for quality and durability rather than on price. The automobile manufacturer sells a Cadillac to the man who intended to buy a Buick, or he sells a Buick to the man who had intended to buy a Ford, or he sells a new Ford to the man who had wanted to buy a second-hand car. And the buyer pays the price for a better car in a large percentage of cases. He also pays a higher price in order to secure strictly fresh eggs, clean, sweet butter, or an all-wool suit of clothes. He does not take bids on these articles and buy on price.

It is only because the building industry has been conducted on the low-bid basis, rather than on the value basis, that the owner insists on throwing his proposition open to every Tom, Dick and Harry who has the nerve to call himself a contractor.

A lot of good could be done if the people engaged in the building business would make a determined effort to sell owners on value rather than on low bids. But where this is impossible they should insist on a cost-plus basis with protection to the owner in the way of a maximum price. The cost plus should not be on a commission basis but on a fixed fee with a bonus to the contractor if the cost is kept below a certain amount and with a lower fee to the contractor if it runs above the maximum amount.

The remedy is easier to prescribe than to enforce, but it will do a great deal to help the building industry if the people engaged in it will stop talking low prices and use their efforts to educate owners to buy on quality and value.

If the automobile manufacturer had followed the methods set by the building trades there would be very few cars except those of the cheap makes. The building industry might well follow the example set by the automobile manufacturers and by those who make other lines of goods which sell on *value* instead of on price.

H. A. DANIEL

President, Atlas Roofing Co.
Newburgh, N. Y.

Any Further Discussion?

Two points of view on the subject of "Bidding Methods", one by a general contractor and the other by a subcontractor, are expressed in the communications reproduced herewith. Mr. Daniel emphasizes the fallacy of buying construction service solely on the basis of price, while Mr. Hotchkiss cites some of the defects of the unit price form of contract.

The Editor of CONSTRUCTION METHODS *will be glad to hear from other construction men with something to say on this topic.*

SIR: I have read Mr. Locher's article on "Bidding Methods" in the November issue of *Construction Methods* and I am glad to see some one advocating the cost-plus-a-fee method of bidding. I have bid on and have been connected with the execution of unit price, lump-sum, percentage and fee contracts, and the fee contract is the fairest one both to owner and contractor which has yet been devised.

Unit price contracts are widely used but they have one outstanding defect. In preparing the bid the overhead must be distributed over a given number of units. If the units actually built vary from the number bid on—and they usually do—the distribution of the overhead is all wrong. I have seen contracts which should have shown a profit finished at a loss from this cause alone.

The lump sum contract is of little value unless accompanied by unit prices to cover changes in quantities and it is then subject to the same objection mentioned for a unit price contract, though not in the same degree. As usually written, such contracts provide only one set of unit prices for both additions and deductions. One set of unit prices cannot be made to fit both conditions. It is difficult to make them fit even if separate units are given for both additions and deductions, for the contractor must gamble on the kind and extent of changes which may be made. One kind of change may effect his overhead very little while another kind may vitally affect it. If the changes are extensive, not only his overhead but his unit costs will be affected.

The straight cost-plus-a-percentage contract is, in general, demoralizing to the contractor's own organization. It is true that "even the mules know when they are on a cost plus job," yet this form of contract does have its uses. Sometimes it is necessary to get the work under way and execute it with the plans only a step ahead of the field work. In other cases the amount and kind of work which must be done is so uncertain that no intelligent estimate of cost can be made. In such cases a cost-plus-a-percentage contract must be used. I know of one job on which the contractor offered the owner his choice of a cost-plus-a-percentage or a cost-plus-a-fee contract. The work was to cost something over $500,000 and the hazards and uncertainties were unusually small. Yet the owner accepted the cost-plus-a-percentage contract and was wholly satisfied with the results.

These exceptions do not change the fact that this type of contract should be avoided wherever possible and that it is in the contractor's own best interest to avoid it.

Mr Locher speaks of the form of contract he suggests as a sliding-scale, fixed-fee contract. I think of a fixed-fee contract as one under which a stated fee is paid, regardless of the cost of the work; and a sliding-fee contract as one under which the fee slides up or down in accordance with the ratio of actual cost to estimated cost. I have had to do with a few fixed-fee contracts and with a large number of sliding-fee contracts involving many millions of dollars. I do not know of one single instance in which the owner and the contractor have not been wholly and completely satisfied with this form of contract. I do know of numerous instances in which the owner has awarded additional contracts to the same contractor on the same basis.

The sliding-fee feature of such contracts may be varied in many ways. I think Mr. Locher's specific example is not fair to the contractor. He may have his fee reduced 90 per cent but he cannot have it increased more than 40 per cent. He should have the same chance to win that he has to lose. In my own experience the contractor was paid 50 per cent of the saving under the estimate or penalized 50 per cent of the excess cost over the estimate, both saving and penalty being limited to one-half the bid fee; any further difference between estimated and actual cost was for the benefit of, or at the expense of, the owner, as the case might be.

In Mr. Locher's specific example of a tunnel estimated to cost $4,000,000, with a bid fee of $280,000 this would work out as follows: If the work cost only $3,720,000 the saving under the estimate would be $280,000. One half of this, or $140,000, would be added to the contractor's bid fee, giving him a total fee of $420,000, or 10½ per cent of the estimated cost. If any further saving under the estimate were realized it would be for the benefit of the owner. On the other hand, if the work cost $4,280,000, one-half of the excess cost, or $140,000, would be deducted from the contractor's bid fee, leaving him a minimum fee of $140,000, or 3½ per cent of the estimated cost. Any further excess cost would be at the expense of the owner. In other words, the contractor would be assured of 3½ per cent and he might make 10½ per cent.

I do not agree with Mr. Locher's suggestion that the estimate of cost upon which the bid is based be prepared by some independent estimating agency. In speaking of this I do not refer to the contractor who guesses at his estimate. He is not a business man, but a gambler. I have in mind only the contractor who keeps careful cost records, who never makes anything more important than a preliminary or approximate estimate without first visiting the site of the work, studying the local conditions, getting such material, labor and subcontract prices as may be needed and then makes a careful estimate, including a study of the kind, quantity and arrangement of equipment needed for the economical and efficient execution of the work. If all other types of contractors could be eliminated the construction industry would be greatly benefitted and the owner would be relieved of most of the dangers of incompetence or worse from which he now suffers. Such a contractor knows his costs, his organization and its methods and ability and is much better qualified to estimate how much a job will cost him than any outside agency can be.

There is nothing in having the contractor prepare his own estimates which is inconsistent with the idea of a sliding fee contract. I think few contractors would bid on another man's estimate without first making their own estimate. I have made many proposals in which the estimated cost, the bid fee and the sliding fee features were definitely stated and in which the items entering into the estimated cost were outlined in enough detail so that there was little chance for misunderstanding as to what was or was not included.

In conclusion I wish to say that I have been greatly interested in all of Mr. Locher's articles and feel that he is contributing a very real service to a business which, like Topsy, "just growed", and which is urgently in need of such constructive thinking and writing as he is doing.

LOUIS J. HOTCHKISS

Regan & Hotchkiss,
Engineers & Contractors
Oak Park, Ill.

UNUSUAL EQUIPMENT

Produces Rock for Road Base From Native Ledge

FRENGEL & SNYDER, contractors of New Castle, Pa., specialize in furnishing rock from nearest available native ledges for road base in western Pennsylvania and eastern Ohio. Recently, on a contract for furnishing rock from a sandstone deposit at Brady's Run, Beaver County, they employed unusual methods and equipment, applicable to any contract of similar character.

Ordinarily they use jackhammers to drill for primary, as well as secondary, shooting. Primary blasting by mudcapping was considered the most advantageous method and was tried for several days, but the progress was so slow that they decided to drill 6-in. holes, spaced about 20 ft. apart, with a churn drill. The face of the ledge was about 40 ft. high. The drilling was done with a new all-steel crawler-mounted Keystone drill, and three holes were completed in about a day and a half. One shot, made in the evening of the second day, brought down several thousand tons of rock.

Specifications usually call for clean rock, of one-man size, to be loaded and hauled to the road under construction. Secondary drilling with jackhammers is, therefore, resorted to for the largest blocks, and chisel and hand hammers used for fragmenting the smaller blocks to one-man size before loading.

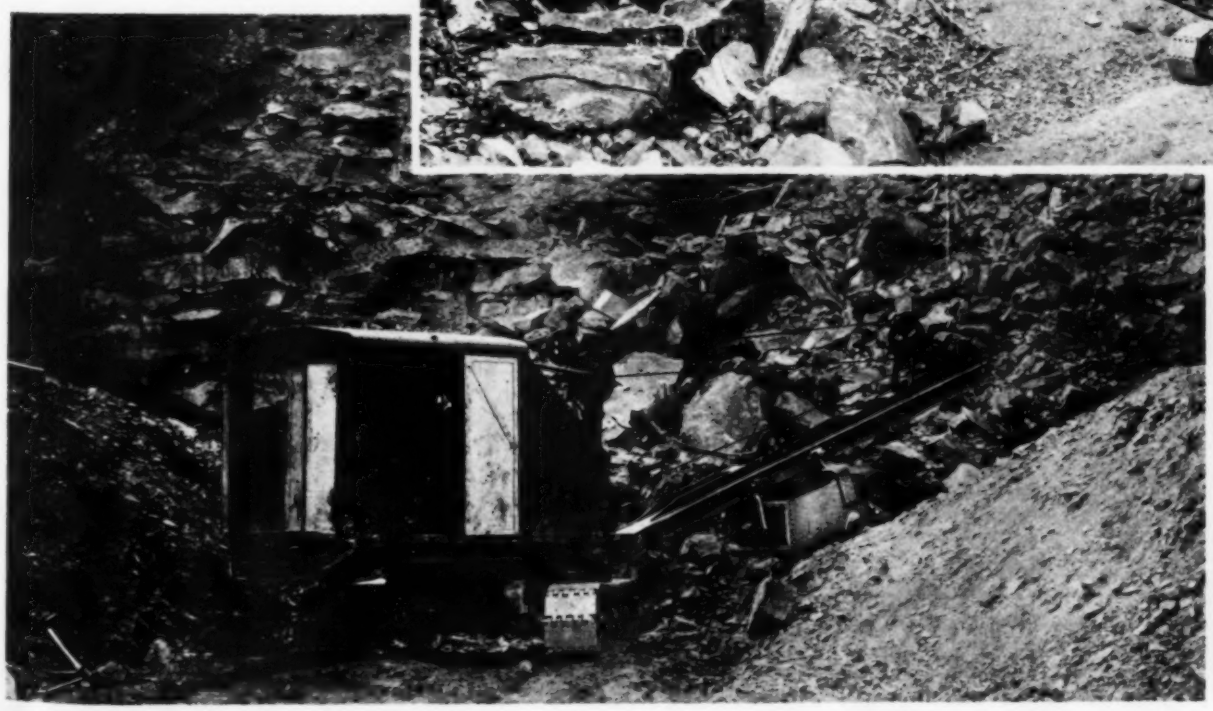
In this case a Keystone 1¼-yd. power shovel, equipped with plunger bucket, was used for sorting the rock and sidecasting dirt and debris. At frequent intervals a 3,000-lb. hammer, attached to a tubular handle and hinged to the end of the boom, was substituted for the plunger scoop to break up oversize rock to proper size. The hammer performed this task in a fraction of the time required by shooting or by hand methods. This reduced the amount of blockholing to be done, as well as the amount of breaking up by hand.

Many of the largest blocks were deeply buried or imbedded in the bank, and "horns" on the hammer were used for prying them loose, as well as for picking them up and laying them down on solid ground where the blows of the hammer would have the most telling effect. The interchange of plunger bucket and hammer was effected in about one hour, as no boom change is necessary with the plunger shovel.

ALL-STEEL CHURN DRILL *(right)*, mounted on crawlers, puts down 6-in. blast holes, spaced 20 ft. apart, to depths of 40 ft. behind face of rock ledge.

"HORNS" on hammer pried loose large blocks of ledge rock imbedded in the bank.

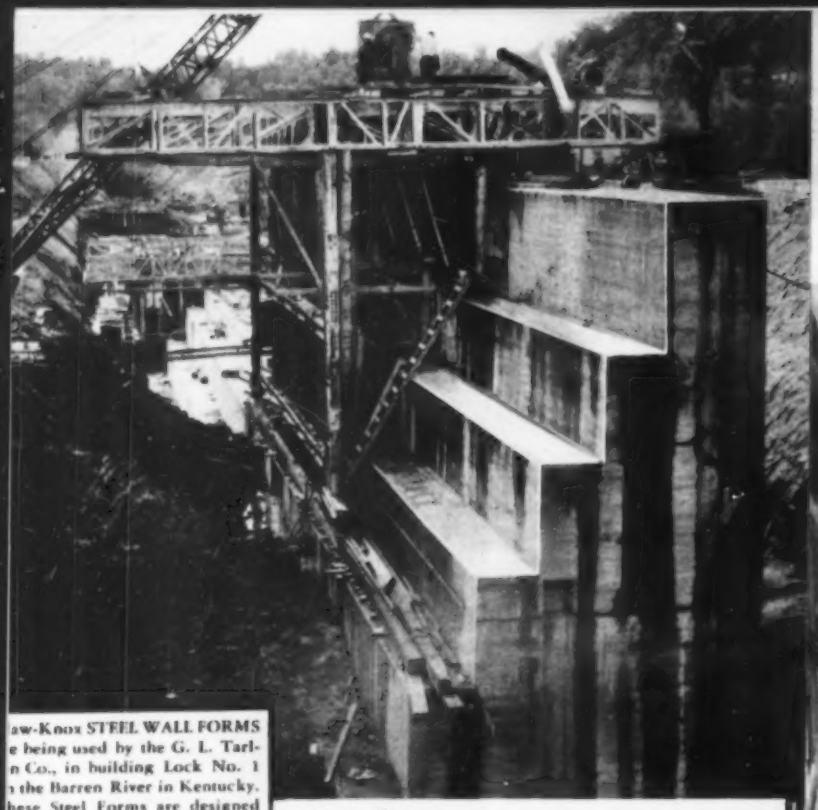
HAMMER *(below)* weighing 3,000 lb., interchangeable with plunger bucket or shovel boom, breaks rock with 22,500 ft.-lb. blows struck at rate of 20 per minute.



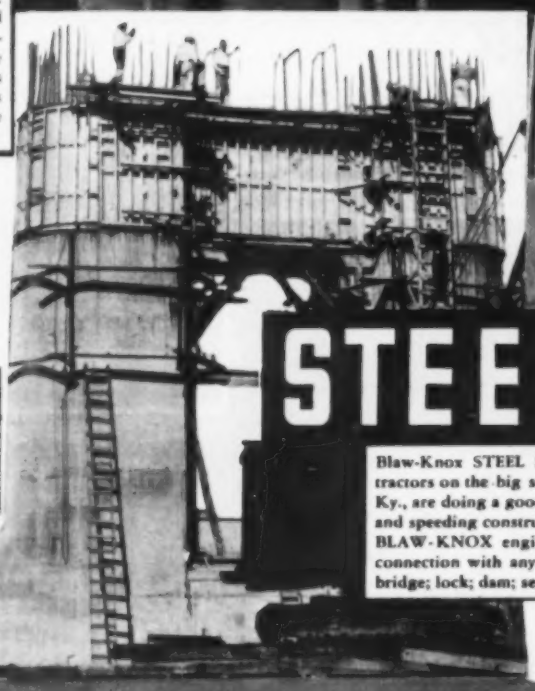
PLUNGER BUCKET *(left)* of 1¼-yd. capacity, on boom of full-revolving shovel, handles blasted rock. Bucket is interchangeable with hammer.

BLAW-KN

for faster —m



aw-Knox STEEL WALL FORMS e being used by the G. L. Tarl- n Co., in building Lock No. 1 the Barren River in Kentucky. hese Steel Forms are designed r quick adjustment to the vary- g wall thicknesses. They are pical of many Blaw-Knox Forms w being used for building locks ong the Mississippi, Tennessee d Ohio Rivers.

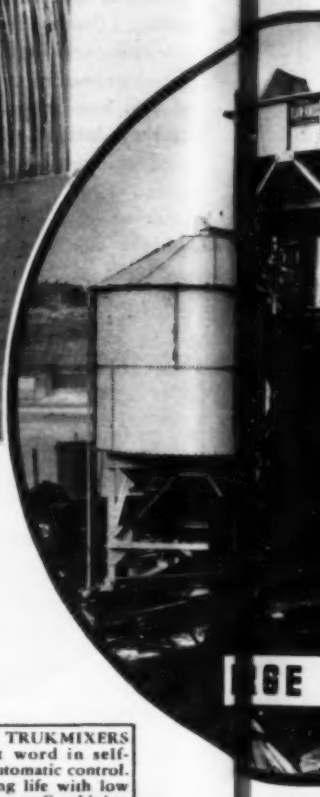


aw-Knox STEEL FORMS are ng used by Siems-Helmers, ., for the PIERS and CAISSONS the huge Mississippi River dge at New Orleans—and on ilar construction by many er contractors doing this class work.

STEEL FORMS

Blaw-Knox STEEL SEWER FORMS used by various contractors on the big sewage project for the city of Louisville, Ky., are doing a good job in maintaining working schedules and speeding construction.

BLAW-KNOX engineering service is at your disposal in connection with any concreting job—wall; tunnel; subway; bridge; lock; dam; sewage disposal plant, etc.



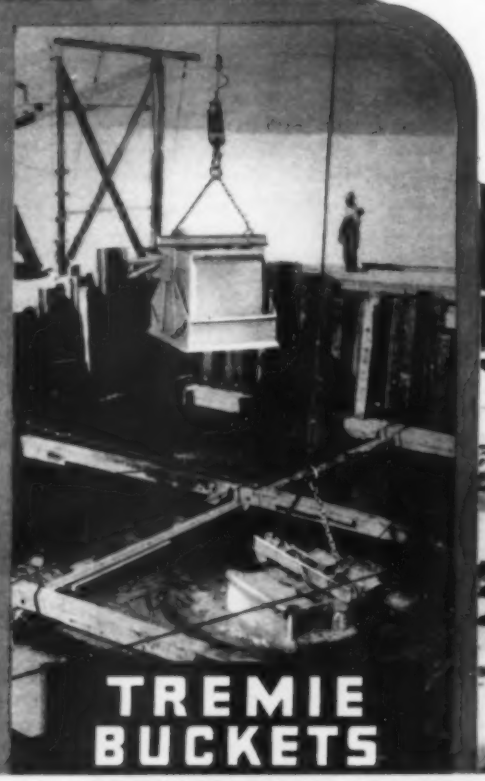
GE

Blaw-Knox TRUKMIXERS are the last word in self-contained, automatic control. Built for long life with low maintenance cost. Combining strength and sturdiness without excessive weight.

TRUKM RS

CONCRETE BUCKETS

aw-Knox CONCRETE BUCKETS are finding idespread favor among contractors. This easy erating roller gate bucket is the only concrete cket which will satisfactorily handle dry, stiff ncretes. Above—Vang Construction Company—legheny River Locks.



TREMIE BUCKETS

Blaw-Knox TREMIE TYPE Concrete Buckets will place stiff concrete in deep water without agitation. The concrete is protected from the surge of the water. The bucket cannot be dumped until it is set down. The Trans-Bay Bridge Company are using them on the San Francisco Bay Bridge.

CLAMSHELL BUCKETS

Blaw-Knox DREADNAUGHT Clamshell Buckets are in use by contractors everywhere for all types of hard digging and fast rehandling. Ball bearing sheaves insure long life with minimum maintenance cost. A complete line of Dragline Buckets is also in widespread use.

B

NOX EQUIPMENT

more profitable work

MORE than ever before, the Blaw-Knox 1934 line of construction equipment exactly fits contractors present and future requirements. New developments and amazing improvements in equipment are in step with projected programs and specifications.

Blaw-Knox equipment helps the contractor to maintain schedules and complete his work on time. It is low in maintenance cost and pays for itself quickly in service. It is modern and in many instances has anticipated specifications. Blaw-Knox equipment helps the contractor to make profits in the face of severe competition.

It's a twenty-eight year old custom among contractors to "deal with Blaw-Knox". This is an especially good habit to continue as it marks the maximum worth in equipment, satisfaction and service to be obtained for the dollar expended.

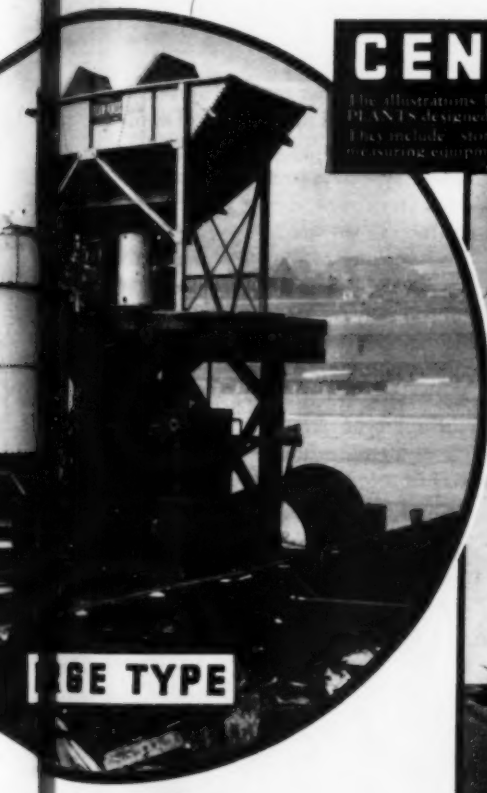
BLAW-KNOX COMPANY - - - 2086 Farmer's Bank Building, Pittsburgh, Pa.

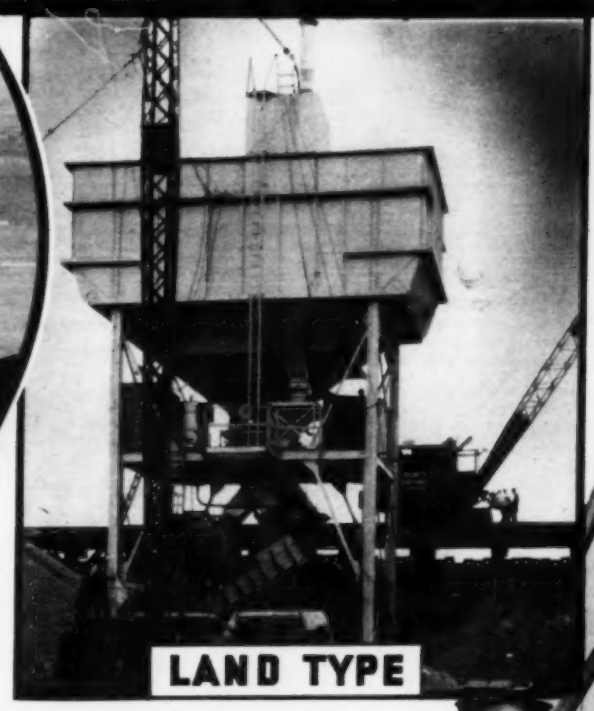
Offices and Representatives in Principal Cities

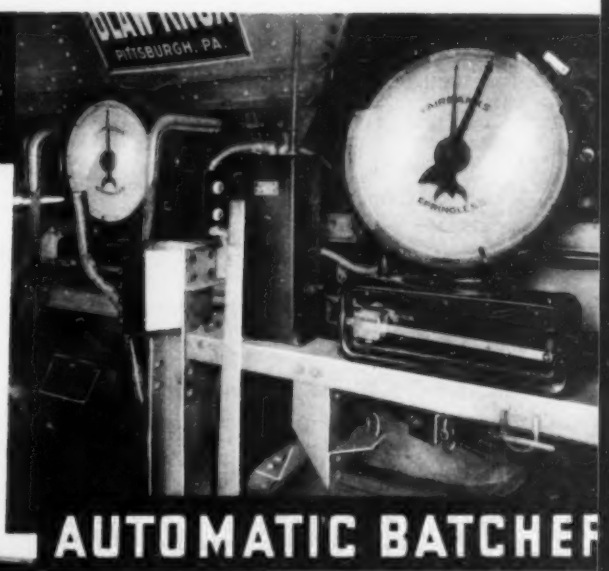
CENTRAL MIXING PLANTS

The illustrations below and to the left are typical of the complete and self-contained CENTRAL MIXING PLANTS designed and built by Blaw-Knox.

They include storage capacity for any required number and quantity of materials; manual or *completely automatic* measuring equipment for aggregates, cement and water. Arranged to feed any size or combination of mixers.

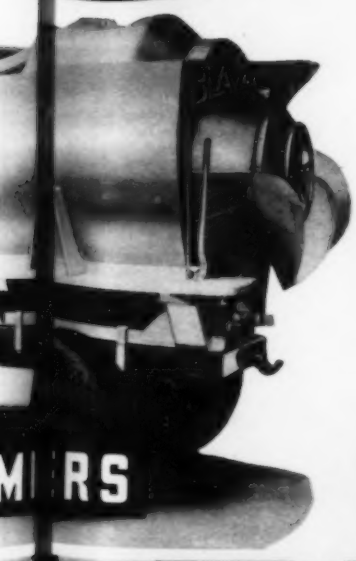






AUTOMATIC BATCHER

Blaw-Knox AUTOMATIC BATCHERS are provided with push-button control for starting feed into the weighing hopper, with automatic cutoff when desired weight of material is reached. Furnished for any required number of aggregates and cement.



This most modern of BULK CEMENT PLANTS is adaptable to delivery of bulk cement by box car, by truck, or from hopper bottom cars — with only minor and economical changes to accomodate each particular job. 50 to 350 bbls.—manual or automatic operation.

BULK CEMENT PLANTS

BLAW-KNOX "LEADERSHIP" CONSTRUCTION EQUIPMENT

also includes:

ROAD FORMS
BATCHER PLANTS
ROAD FINISHING MACHINES
STREET & SIDEWALK FORMS
HYDRAULIC DIRT MOVERS
HYDRAULIC BULLDOZERS
SHEEPSFOOT TAMPING ROLLERS
TRUCK TURNTABLES
CEMENT TANKS
PORTABLE ASPHALT PLANTS
STEEL BUILDINGS
STEEL GRATING

BLAW-KNOX

Cableways Place Concrete in

BOULDER DAM

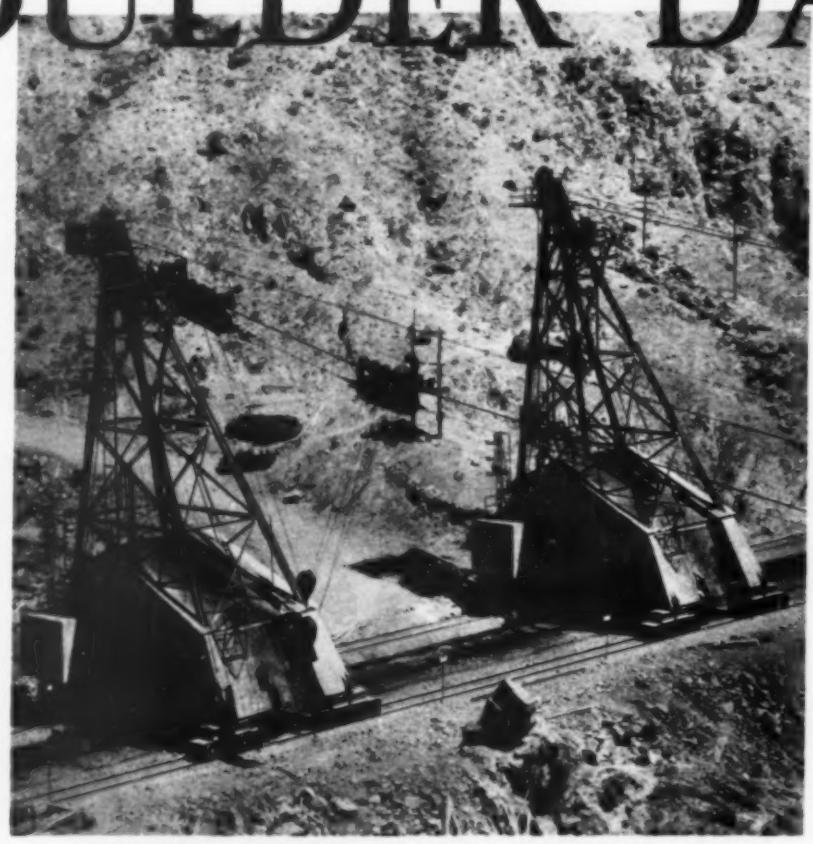
Part One

WITH MONOTONOUS regularity 8-yd. buckets of concrete are swung out and lowered into the forms at Boulder Dam. Looking upstream through the canyon, from the tourist observation point high up on the Nevada canyon wall, the nearest feature is the lower cofferdam, now occupied by extensive shops, field offices and the cooling tower for the refrigeration system to dissipate the chemical heat generated by the setting of cement in the 3,400,000-cu.yd. mass of concrete masonry. Between this unit and the downstream toe of the dam is a length of several hundred feet used for storing miscellaneous equipment and eventually to be occupied by the power plant. Beyond, the dam itself is rising at the rate of about 30 ft. per month and already the downstream slope and the junction with the power house are easily distinguished.

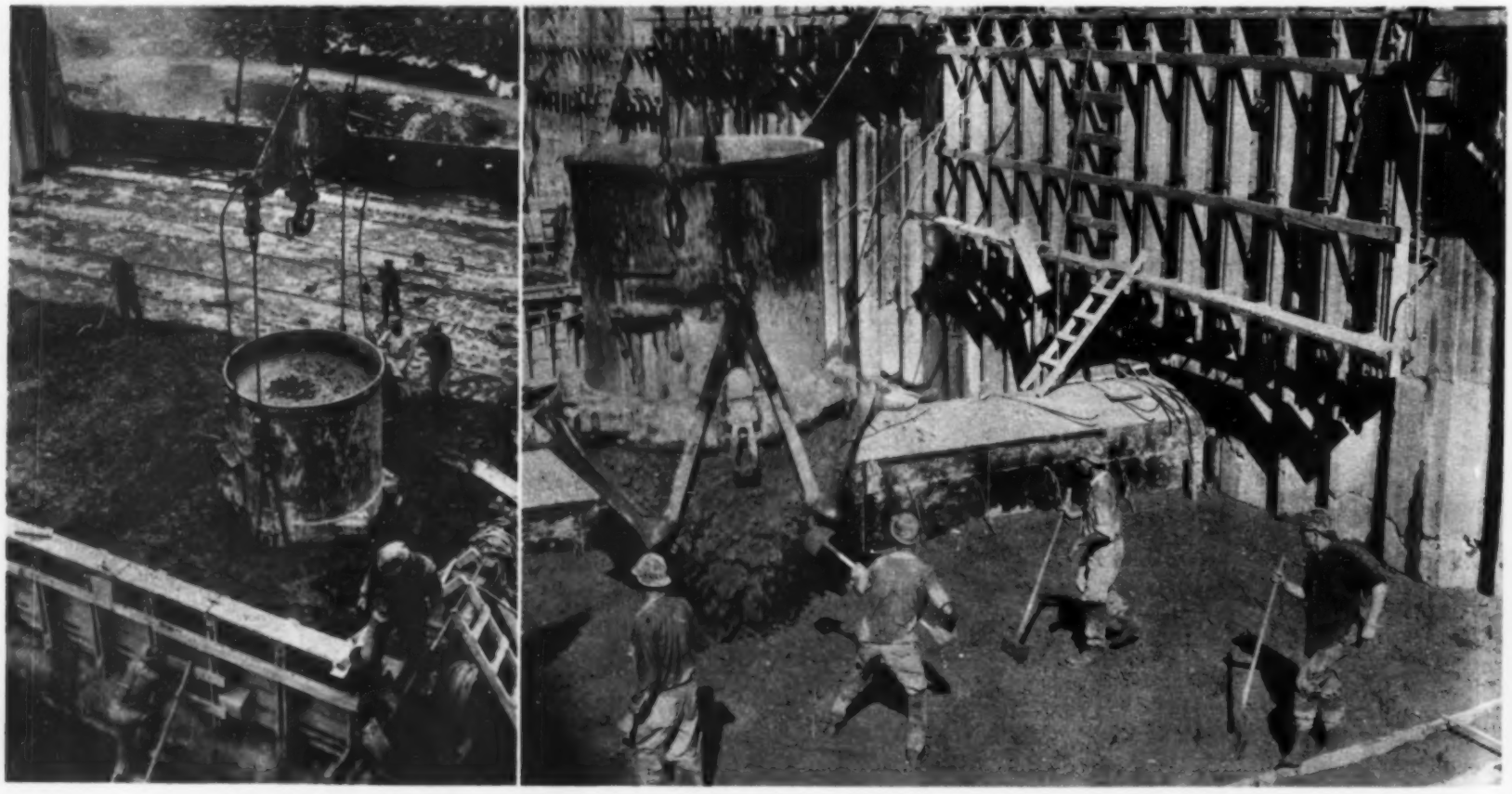
On the left, or Nevada side of the canyon, can be seen the trestle upon which the concrete trains arrive from the low-level mixing plant, and in the extreme background appears the upper cofferdam diverting the flow of the river out of the canyon into one or more of the diversion tunnels, depending upon the volume of flow. Overhead, across the canyon, stretch the half dozen cableway systems used for moving concrete, equipment and other material and forming the backbone of the present transportation systems in the canyon. The gigantic spillway structures are both hidden from view, being located back from the canyon walls.

This constitutes the view which the visitor to the Boulder Dam project gets from the canyon-rim observation point which is open to the public. From the look-out point, however, it is necessary to back-track for perhaps a dozen miles to the aggregate screening plant for the purpose of following the concrete operations in a logical order.

Gravel for aggregate is excavated



TYPICAL HEAD TOWERS and hoist houses on Nevada side of contractors' cableways delivering concrete in 8-yd. buckets to site of Boulder Dam. Track travel is synchronized with corresponding tail towers on Arizona side of canyon.



DEPOSITING CONCRETE in 5-ft. lifts in one of columnar blocks forming main body of dam. Cableway bucket holding 8 cu.yd. is first grounded on surface of lift *(left)* to release safety catches and then is raised by lines attached to rim, allowing gate leaves to swing open *(right)* and discharge concrete.

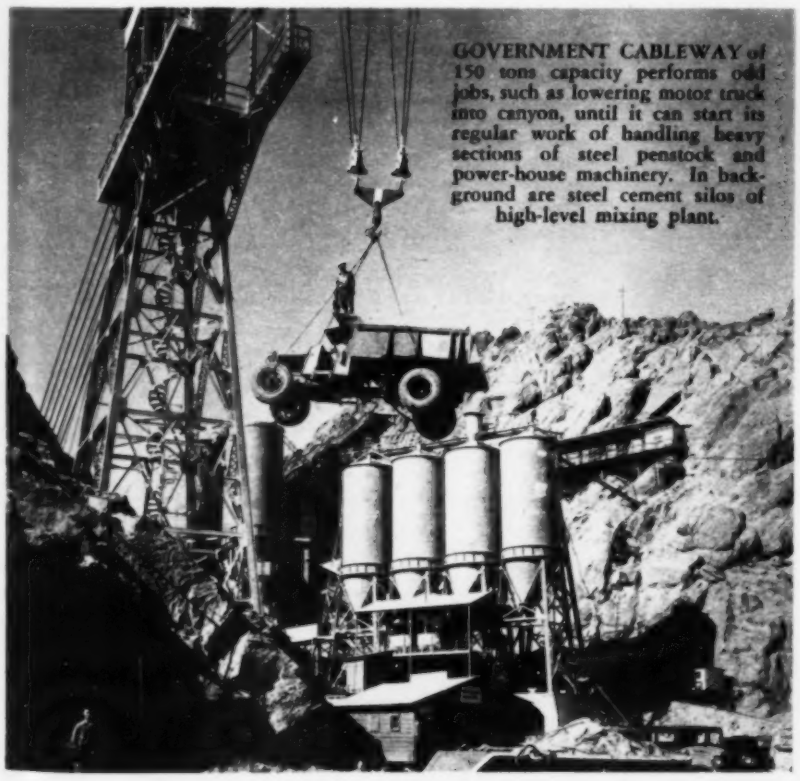
TRESTLE along wall of canyon supports railway cars operated from mixing plant by electric locomotives to deliver 8-cu.yd. buckets of concrete to point where they are picked up by cableway and lowered to forms for base of dam, shown in lower left corner of photograph.

from pits on the Arizona side of the river about 8 mi. upstream from the damsite and transported by railroad train to the screening plant about 2 mi. from the dam. This plant, designed to produce 500 tons of aggregate per hour and actually producing as much as 700 tons per hour for continued periods, is still operating as described in *Construction Methods*, July, 1932, with dry screening, using washing only for the classification of the sand and a final spray. From the screening plant the prepared aggregate is delivered by train either directly to the mixing plant or the finished stockpile where about 400,000 tons has been stored above water line preparatory to completing the dam after reservoir storage floods out the screening plant site.

Cement — Cement manufactured in accordance with special specifications (prepared after elaborate research for the definite purpose of reducing the heat-producing element in the cement and at the same time of providing requirements of strength and durability) is being produced at four cement plants in southern California and shipped in bulk by train. To provide a final product going into the structure which would eliminate the variation resulting from individual characteristics of the cement produced by different mills, including color, the government arranged under separate contract for Six Companies Inc., the contractors, to build a blending plant on the canyon rim near the high-level mixing plant. Here the cement from the mills is unloaded separately into four steel silos and withdrawn by screw conveyor in the proper proportion to provide a final material blended to equal the proportions of total cement furnished by each mill. The mixing effect of the screw conveyor provides the blending.

From the blending plant the cement is pumped by a Fluxo system either to the bins at the high-level plant (100 ft.) or 5,700 ft. to the low-level mixing plant. This mile-long 9-in. pumping line was designed for a capacity of 450 bbl. per hour but has often exceeded 550 bbl. The profile of the line includes a 500-ft. drop from the blending plant to the low-level mixing plant. The pump station at the upper end is supplemented by a duplicate unit half-way along the line; each of these plants operates from the permanent compressed air system and is rated to use 2,000 cu.ft. per min. per plant.

Concrete Mix—Leaving the aggregate plant, the road and railroad line run along the Nevada side of the canyon about 4 mi. into the gorge to the location of the main low-level mixing plant. Here the carloads of aggregate are lifted by conveyor belt into the bins over the batching plant. Johnson batching equipment with automatic control prepares the 4-cu.yd. batches which are mixed for a 2½-min. period in the four



GOVERNMENT CABLEWAY of 150 tons capacity performs odd jobs, such as lowering motor truck into canyon, until it can start its regular work of handling heavy sections of steel penstock and power-house machinery. In background are steel cement silos of high-level mixing plant.

COLUMNAR BLOCKS of concrete, numbering 220 and varying in size from 55x60 ft. to 25x30 ft., form body of 730-ft. high dam. Before joints are grouted concrete, poured in 5-ft. lifts, is cooled by refrigerated water in system of piping imbedded in masonry.

4-yd. Smith mixers. The general characteristics of the mix are shown in the accompanying tabulation. Specifications require a slump of 3 in. at the point of placement in the dam and the conditions of temperature and humidity result in a loss of approximately 0.6 in. between the mixer and the dam so that the concrete is mixed with a slump of about 3.6 in.

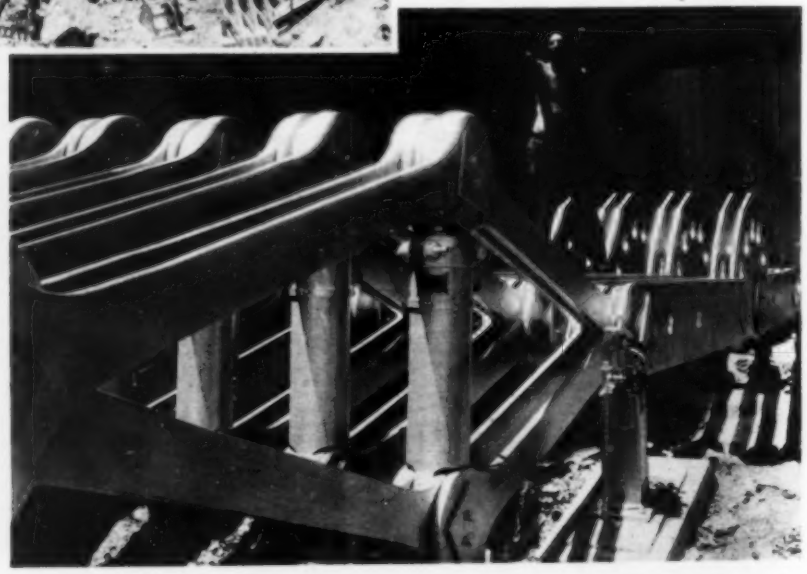
The mixers discharge in pairs directly into 8-cu.yd. buckets which are handled by electric train between the mixing plant and the dam. Each train consists of a single standard-gage flatcar which has four docking compartments and operates with two buckets in place in alternate compartments to facilitate the transfer of buckets by cableways at the site. Spacing of these compartments on the cars is such that with the two buckets in alternate pockets they match the spacing of the mixers and can be loaded with a 4-yd. charge apiece at the same time. As soon as they have received the first 4-yd. apiece they are moved in under the other two mixers and the top half of each bucket filled. Seven trains are provided and there is no delay for lack of transportation at either end of the system.

The concrete trains are handled by electric locomotives equipped for both third rail and storage-battery operation. This provision eliminates the need for the dangerous third rail around the plant and at the cross-overs and, at the same time, takes the peak demand off the direct-current generating station, equalizing the load. The double track railroad line extends 4,000 ft. to the damsite and includes two 1,000-ft. tunnels and a railroad bridge of two 130-ft. trusses. At the site the railroad is supported along the canyon wall on a one-leg trestle.

The railroad line is at El. 720, the level of the cofferdam crest, and concrete placing operations will continue until the dam reaches this height, when the railroad extending beyond the upstream face of the dam will have to be removed. From El. 720 to El. 950 the plan is to transfer the concrete buckets to the cableways at the upstream face by a large stiff-leg derrick built with its base at the level of the intake tower foundations. Aside from this transfer, required because all the cableways serving the dam will not reach the upstream face, the concrete placing methods will be the same. When the dam reaches El. 950 the specifications require that storage be started in the reservoir and the low-level mixing plant will have to be removed. Above this level concrete will be supplied from the high-level mixing plant, whose present capacity of two 4-yd. mixers will be doubled. Concrete will move out by truck or train along the edge of the canyon and be picked up directly by the cableways.

CAPACITY 150 TONS ***(left)*** **Tower and anchorage of permanent government cableway, with 1,200-ft. span across power-house site below Boulder Dam. Track composed of six 3½-in. cables, spaced 18½ in. on centers, extends to anchorage (lower right corner) equipped with tension adjusters.**

SOCKETS AND YOKES at end of Government cableway track cables make connection with tension adjusting toggles.



TENSION ADJUSTMENT of track cables of 150-ton cableway is made by toggles equipped with hydraulic jacks at Nevada anchorage.

Buckets—Design of the 8-yd. buckets originated with Frank T. Crowe, general superintendent, and the details were worked out in the engineering office of Six Companies Inc. The buckets are of welded construction, using ¼-in. steel plate; they are 6 ft. in diameter and 8 ft. high. Bottom dump is provided by two semi-circular doors hinged at the edge of the bucket. There are two cable attachments, one to the rim of the bucket, used for emptying and the other attached directly to the doors to maintain them in closed position while the bucket is being moved. This handling of the buckets with the lines on the doors eliminates possibility of dropping a load. In addition, as a safety precaution, there is a latch for the doors on either side of the bucket which does not open until the loaded bucket is set on the surface of the concrete prior to dumping.

Cableways — The cableway system built by the contractor to provide transportation facilities over the entire dam and power-house site is flexible and non-interfering with other operations. There are five major units in the contractor's system in addition to the large

BOULDER DAM MASS CONCRETE

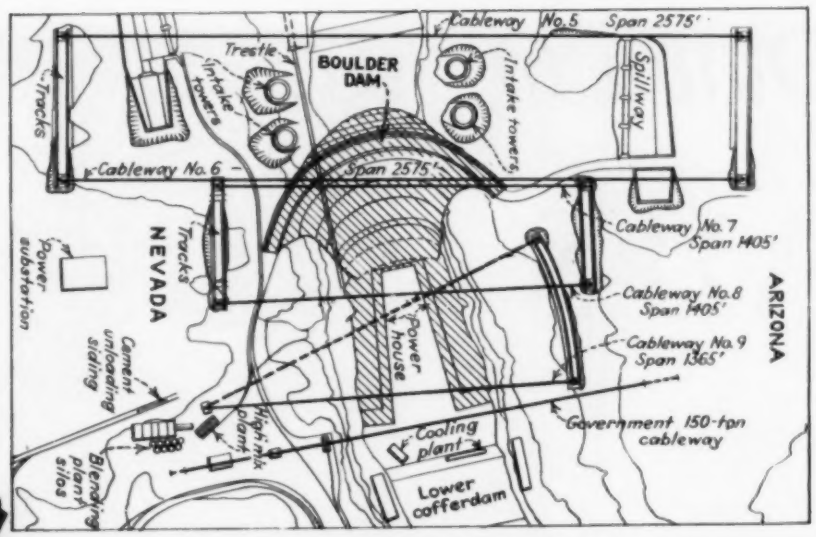
MIX 1:2.45:7.05 – 9" MAXIMUM SIZE

INDIVIDUAL PARTS BY WEIGHT

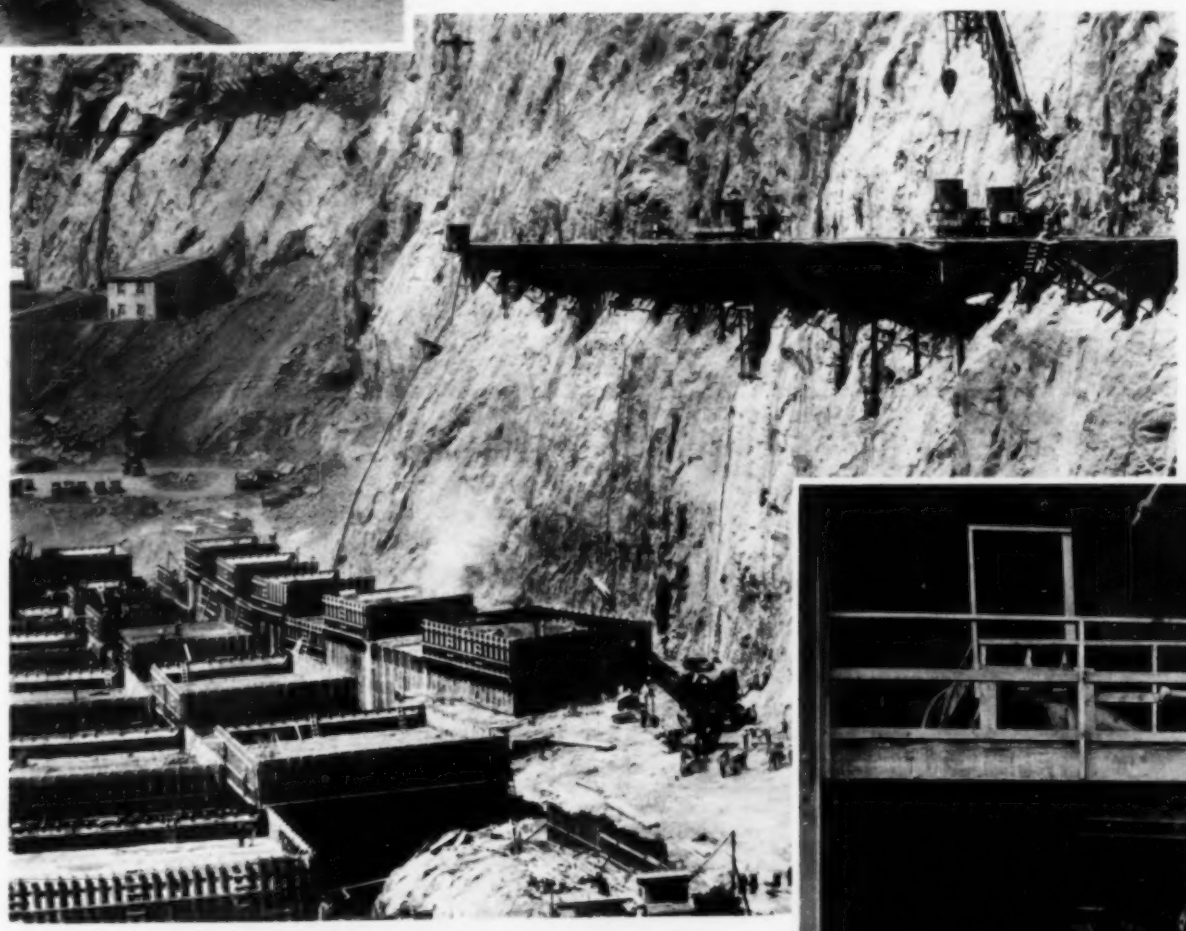
CEMENT	SAND	#4 – ⅜"	⅜" – ¾"	¾" – 1½"	1½" – 3"	3" – 6"	6" – 9"
1	2.45	0.72	1.03	1.46	1.66	1.52	0.66

LOW HEAT CEMENT.....ARIZONA AGGREGATE
W/C = 0.54 WT.....SLUMP = 3¼".....UNIT WEIGHT = 155.5 LB./CU.FT
CEMENT YIELD = 1.01 BBLS./CU.YD.....PASTE CONTENT = 19.5 %
28 DAY UNIT STRENGTH IN 36"x72" CYLINDER = 3100 LB./SQ IN
MODULUS OF ELASTICITY = 5,200,000.....POISSON'S RATIO = 0.18

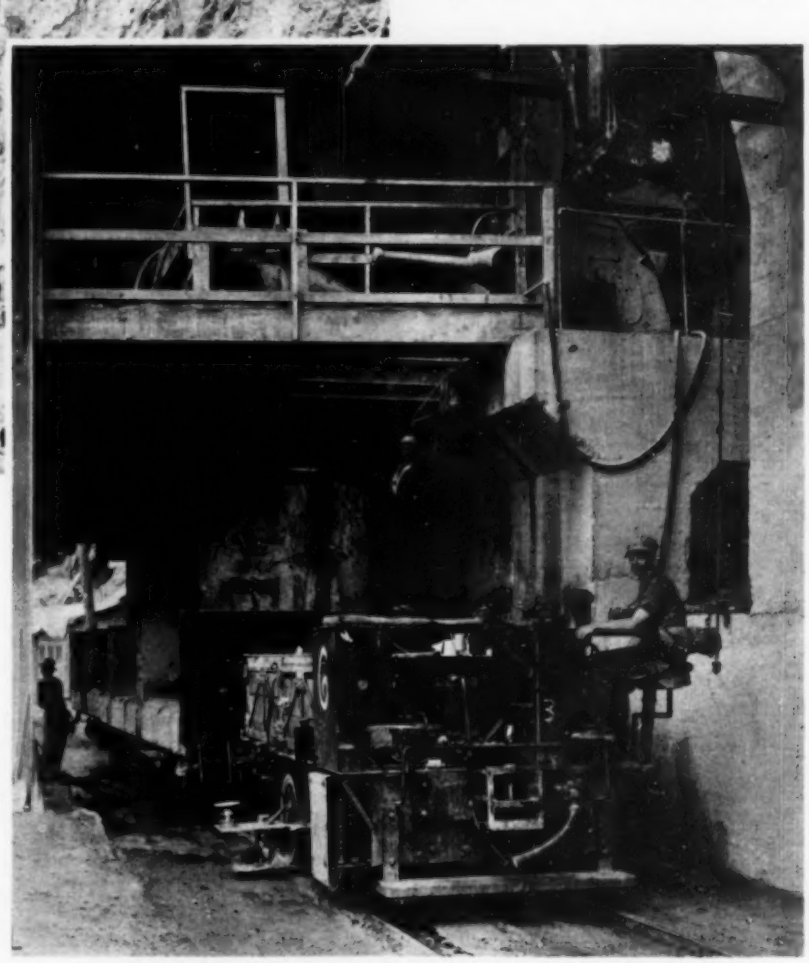
8-YD. BUCKET *(below)* for concrete is of all-welded ¼-in. steel plate construction, 6 ft. in diameter and 8 ft. high, designed by Frank T. Crowe, general superintendent for contractors.



CABLEWAY LAYOUT to serve Boulder Dam includes five 25-ton construction units for delivery of concrete and one permanent 150-ton Government cableway for handling penstock pipe sections and heavy power-house machinery.



ONE-LEGGED TRESTLE, perched on Nevada side of canyon, carries double-track railroad for delivering 8-yd. concrete buckets to point of pick-up by cableways.



LOADING TRAIN of two 8-yd. buckets at concrete mixing plant for delivery, by electric locomotive haulage, to cableways. Each train receives output of four 4-yd. mixers. Haul from mixers to damsite is 4,000 ft.

150-ton government cableway installed for permanent operation at the downstream end of the site.

The upstream pair, covering most of the dam proper, have a span of 2,575 ft. and operate on parallel track runways with a lateral movement of about 800 ft. This half-mile span was necessary to reach the spillways to handle concrete for these structures. The runway for the tail towers on the Arizona side of the canyon required a fill of 500,000 cu.yd., 150 ft. high. Much of this fill came from the spillway excavation and part from the cut at the other end of the runway. The head and tail towers are 90 ft. high to secure the necessary vertical clearance over the intake towers.

Next downstream is a second pair operating on concentric radial tracks. This double unit has a span of 1,405 ft. and, again, the location presented construction problems, including a 100-ft. cut for the Arizona runway and high steel trestles on the Nevada side.

Joining this second pair on the downstream side is a 1,365-ft. span radial unit with a fixed head tower on the Nevada side and a traveling tail tower on a track about 800 ft. long. This unit completes the coverage of the power-house site and joins on the downstream edge of its travel, the fixed 150-ton cableway built by the government as a permanent installation.

For obvious reasons the five contractors' cableways are duplicate units in as far as possible. They are all rated at 25-ton capacity with some provisions for occasional overload. All operating equipment is housed in the head towers on the Nevada side and the hoists, sheaves and carriages were furnished by Lidgerwood Manufacturing Co. The track cables are 3-in. locked-coil furnished by the American Steel & Wire Co. The endless rope is 1 in. and the hoisting lines are ⅞ in. in diameter.

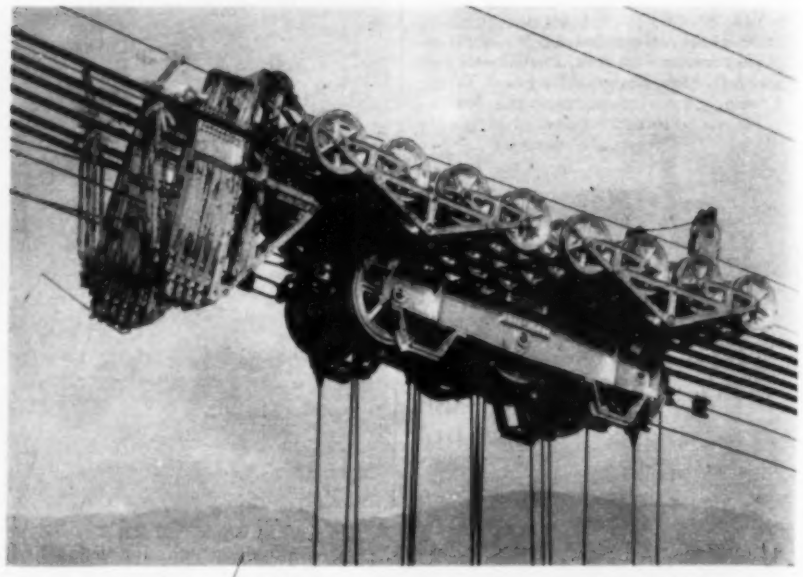
A 500-hp. electric motor operates each main hoist and is provided for regenerative braking, magnetic reversing control and counter-torque deceleration while lowering. The maximum speed of the carriage along the track is 1,200 ft. per min. Hoisting speed is 300 ft. per min. and 420 ft. for lowering. Movement along the runways is provided by a 100-hp. motor in each tower operating through properly synchronized remote control at a speed of 50 ft. per min. through a three-part line. Motor driven compressor units in each head-tower provide air for operating brakes and clutches. The cableway operator, in every case, is located in the head-tower hoist-house and does not see the load or, in most cases, the canyon at any time. His operations are directed entirely by bell and telephone signals.

(To Be Concluded Next Month)

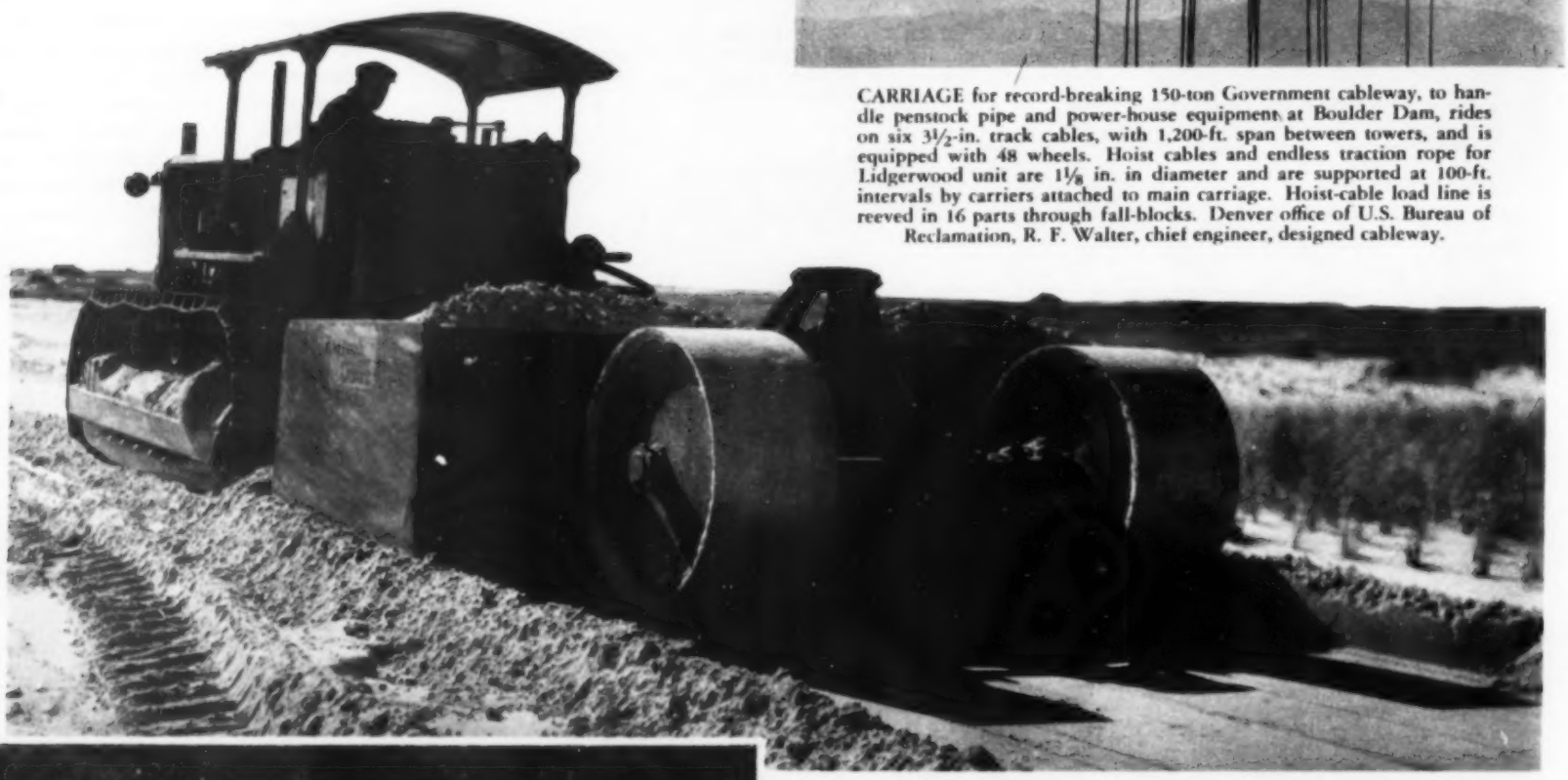
Getting Down to

DETAILS

Close-up Shots of
Job Methods and Equipment

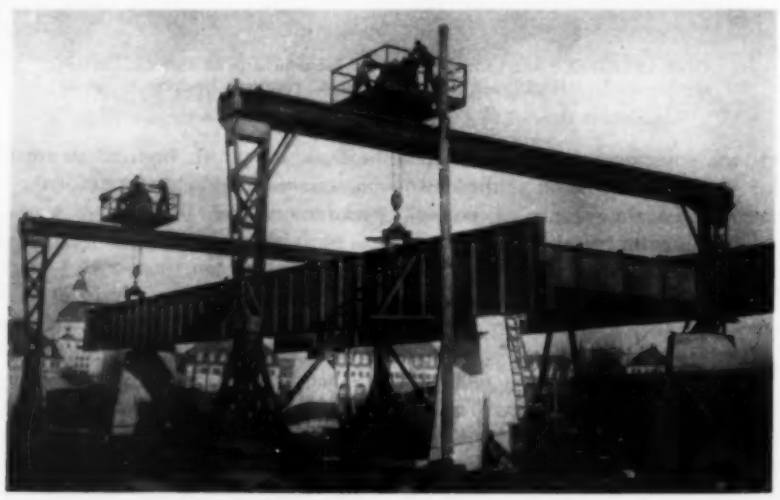


CARRIAGE for record-breaking 150-ton Government cableway, to handle penstock pipe and power-house equipment at Boulder Dam, rides on six 3½-in. track cables, with 1,200-ft. span between towers, and is equipped with 48 wheels. Hoist cables and endless traction rope for Lidgerwood unit are 1⅛ in. in diameter and are supported at 100-ft. intervals by carriers attached to main carriage. Hoist-cable load line is reeved in 16 parts through fall-blocks. Denver office of U.S. Bureau of Reclamation, R. F. Walter, chief engineer, designed cableway.



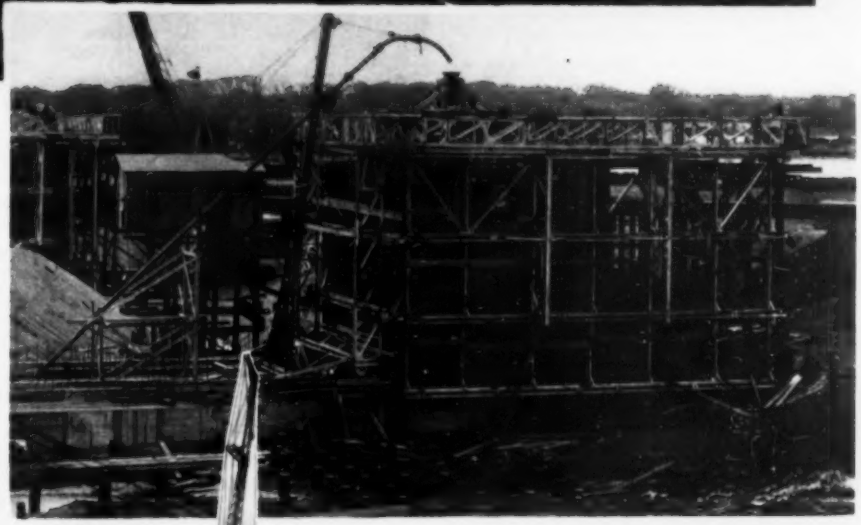
6-YD. BOTTOMLESS HYDRAULIC SCOOP of La Plant-Choate design drawn by Caterpillar diesel 75-hp. tractor moves 600 yd. of sand per 12-hr. day on 500-ft. haul with fuel consumption of 5 gal. of oil per hour. Davis Construction Co. of Seaford, Long Island, N. Y., operates unit on 200,000-yd. grading subcontract under Johnson, Drake & Piper, Inc., general contractor on roadway and bridge project at a New York State park for Long Island State Park Commission. Three scoops are used by subcontractor, two being operated by Caterpillar 60-hp. gasoline tractors. More powerful diesel tractor performs about twice as much work with 6-yd. scoop as older 60-hp. units.

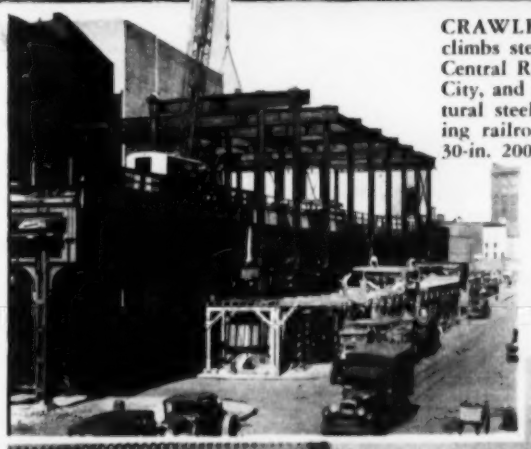
BROOM ATTACHMENT for road roller installed in 15 min. eliminates hand sweeping and assures better filling of voids in macadam pavement construction. Continual sweeping reduces amount of rolling required and conserves fine material. Freeman mechanical sweeper attachment operates with roller moving in either direction. Can be raised from surface when not in use.



TWO GANTRY CRANES are used to erect shop-welded girders (from 72½ to 86 ft. long) and floor beams of 1,040-ft. Schlachthof bridge in Dresden, Germany, longest welded bridge in Europe. Girders are 80 in. deep and are spaced 29½ ft. apart to support 33½-ft. roadway.

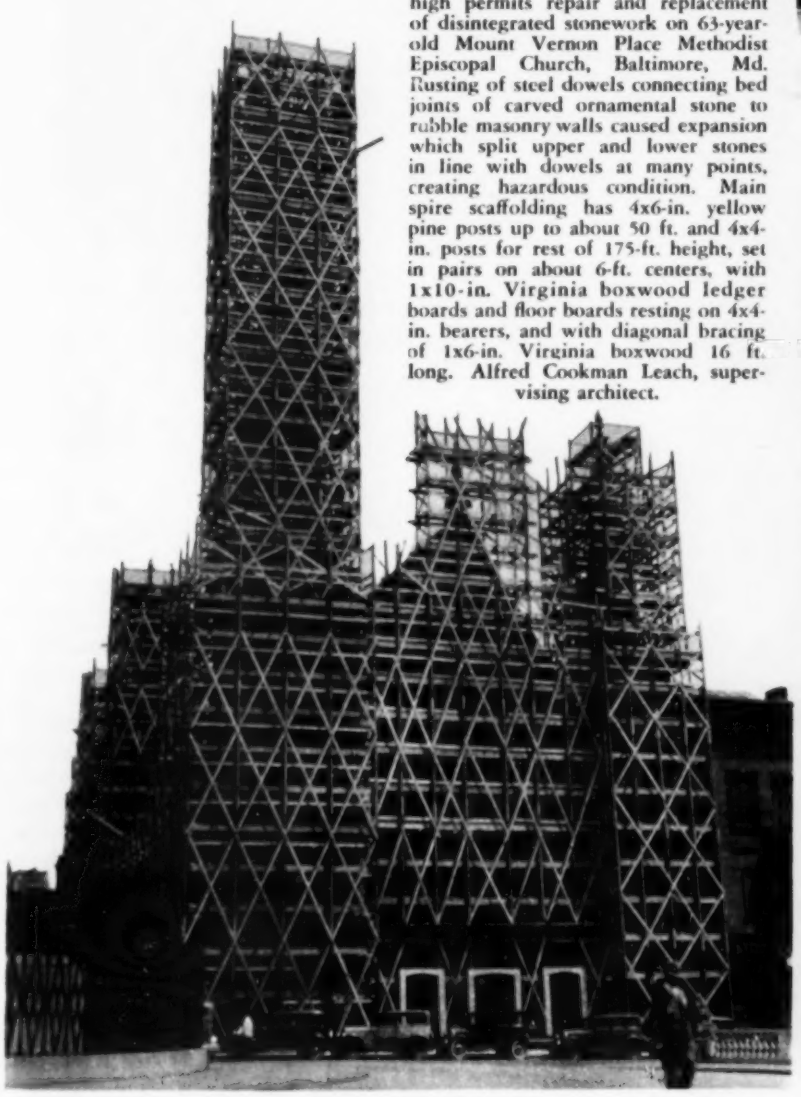
PUMPED CONCRETE *(above and at right)* involving a total volume of 110,000 cu.yd., is used in construction of locks No. 4 and 5, identical structures on Upper Mississippi River at Alma, Wis., and Minneiska, Minn. Through 7-in. pipe in 10-ft. lengths with flange and lever couplings Rex double-cylinder, reciprocating units, driven by 55-hp. gasoline engines, deliver concrete from mixers direct to forms. Maximum distances pumped were 1,150 ft. horizontal and 50 ft. vertical. Proportioning of concrete was by water-cement ratio using not less than 5 bags of cement per cubic yard and not more than 6½ gal. of water per bag of cement. Maximum size of coarse aggregate was 3 in. Under direction of Corps of Engineers, U.S. Army (Col. E. L. Daly, division engineer at St. Louis and Major Dwight F. Johns, district engineer at St. Paul) the two locks were built by the Ouilmette Construction & Engineering Co., of Chicago, and the E. F. Gillen Co., of Milwaukee.





CRAWLER CRANE *(left and below)* climbs steep ramp to deck of New York Central R.R. elevated viaduct, New York City, and rapidly erects 660 tons of structural steel for frame of warehouse bridging railroad structure. Ramp consists of 30-in. 200-lb. girders on timber cribbing. Speedcrane, belonging to Gerosa Crane Service Co., of New York City, with boom extended to 75 ft., handles girders up to 10¾ tons in weight. Harris Structural Steel Co., New York, contractor.

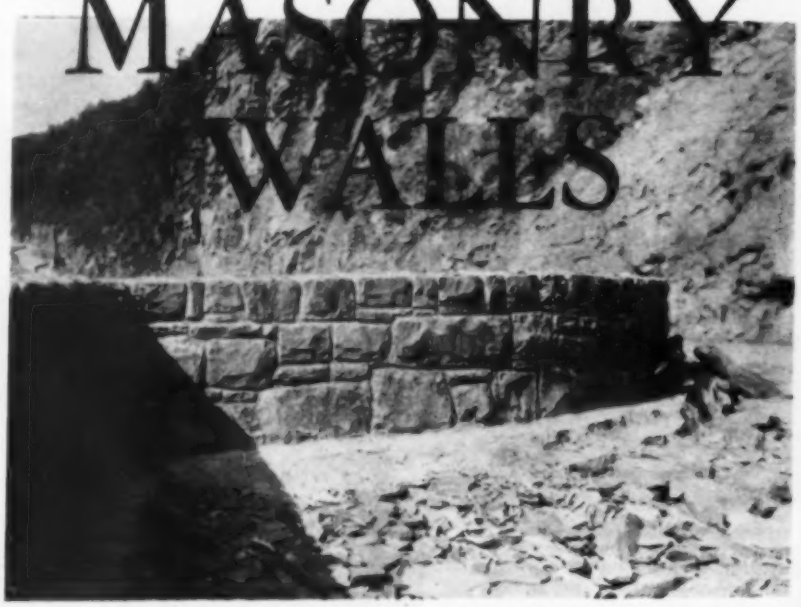
WOOD POLE SCAFFOLD covering exterior walls and main spire 175 ft. high permits repair and replacement of disintegrated stonework on 63-year-old Mount Vernon Place Methodist Episcopal Church, Baltimore, Md. Rusting of steel dowels connecting bed joints of carved ornamental stone to rubble masonry walls caused expansion which split upper and lower stones in line with dowels at many points, creating hazardous condition. Main spire scaffolding has 4x6-in. yellow pine posts up to about 50 ft. and 4x4-in. posts for rest of 175-ft. height, set in pairs on about 6-ft. centers, with 1x10-in. Virginia boxwood ledger boards and floor boards resting on 4x4-in. bearers, and with diagonal bracing of 1x6-in. Virginia boxwood 16 ft. long. Alfred Cookman Leach, supervising architect.



Mountain Highway Retained by Stone

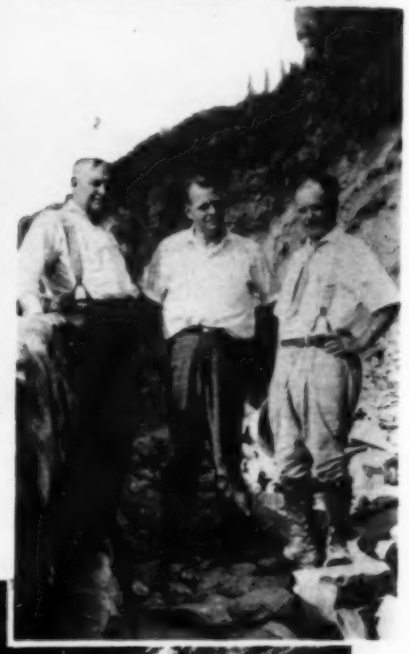
MASONRY WALLS

STONE MASONRY retaining walls up to 33 ft. deep and parapet walls devoid of coping form the outstanding feature of the mountain section of a 3½-mi. highway contract recently completed by the Miller Bros. Construction Co., of Hartford, Conn., for the New York State Department of Public Works, between Port Jervis and Mongaup. Clinging to steep mountain slopes 275 ft. above the Delaware River, this portion of the project called for 4,200 ft. of stone retaining wall and guard wall. By incorporating a large amount of natural rock in the retaining walls, the quantity of quarried stone required was held down to 14,000 yd. This stone was produced from a quarry on the right-of-way. Sidehill rock cuts up to 75 ft. high were made in carving a ledge for the highway on the steep slopes, which incline at angles with the horizontal of 60 deg. to 90 deg.



NO COPING on this stone masonry parapet wall, which forms guard barrier on top of retaining wall.

A. C. STERNBERG *(left)*, president, Miller Bros. Construction Co.; A. C. STERNBERG, Jr.,; and H. H. FELDMANN, resident engineer.



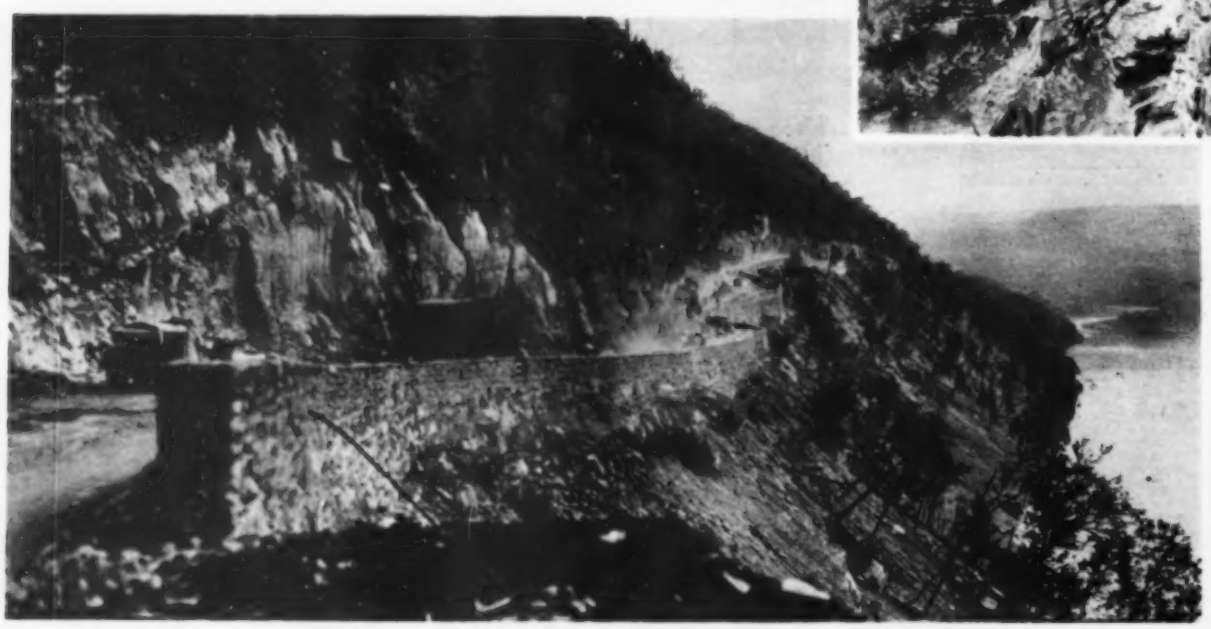
Location of Project—State Route 97, between Port Jervis and Narrowsburg, on the Delaware River, included two short unimproved sections, one of which was relocated and paved under the 3½-mi. contract of the Miller Bros. Construction Co. About 1 mi. of this section lies along a steep mountain side, where the channel of the river cuts close to the base of the mountain. The rest of the project traverses rolling valley terrain approaching streams at both ends of the 3½-mi. length. At the north end of the project the highway crosses the Mongaup River on a 220-ft. deck truss and girder bridge with a main truss span of 140 ft. A small stream at the south end of the section is bridged by a reinforced-concrete T-beam structure with a 40-ft. span. Both of these bridges were included in the contract.

Because of the difficult topography in the mountain section the new highway follows the old location fairly closely along the steep slopes, where the efforts of the engineers were directed chiefly toward widening the highway and improving the curvatures and grades. Extensive wall building and sidehill cutting was necessary to attain these objectives.

To assist in maintaining center-line stakes in this section of rugged topography, the engineers ran an auxiliary location line approximately parallel with the center line of the highway on the mountainside above the road and established reference points along this auxiliary line. Points on the line of the highway then could be located as often as required by triangulation from the reference points.

As part of this contract, the project was paved throughout its length with a concrete slab of 8-7-8-in. cross-section, 20 ft. wide. In the mountain section, a 4-ft. concrete gutter was constructed on each side of the pavement, serving to increase the effective width of the driving surface to 28 ft. In addition, the pavement was widened at six locations in this 4,200-ft. section to provide parking areas where cars may stop clear of the traffic lanes while the passengers view the scenery of the river canyon. Natural rock promontories were utilized in locating these parking areas, which vary from 50 to 200 ft. in length and

RETAINING WALLS vary in depth up to 33 ft. in accordance with foundation conditions. Concrete footings often are placed on deep, irregular rock foundations.



CURVING HIGHWAY along steep mountain slope above Delaware River is constructed with masonry retaining and guard walls of local stone.

from 8 to 18 ft. in width. Transition sections 25 and 50 ft. long were used in turning out the wall from normal pavement width to the greater width at the parking areas. The engineers on the project preferred the appearance of the shorter turnouts.

All curves on the project are banked, and, in the mountain section, where a succession of reverse curves is found, nearly the entire 4,200 ft. required banking. Because the curves in this section are short, however, the superelavation at no point is particularly great. The top of the parapet wall parallels the outside edge of the concrete pavement, rising and falling in conformity with the banking of the curves. Grades on the project are not excessive, the steepest gradient being 7½ per cent.

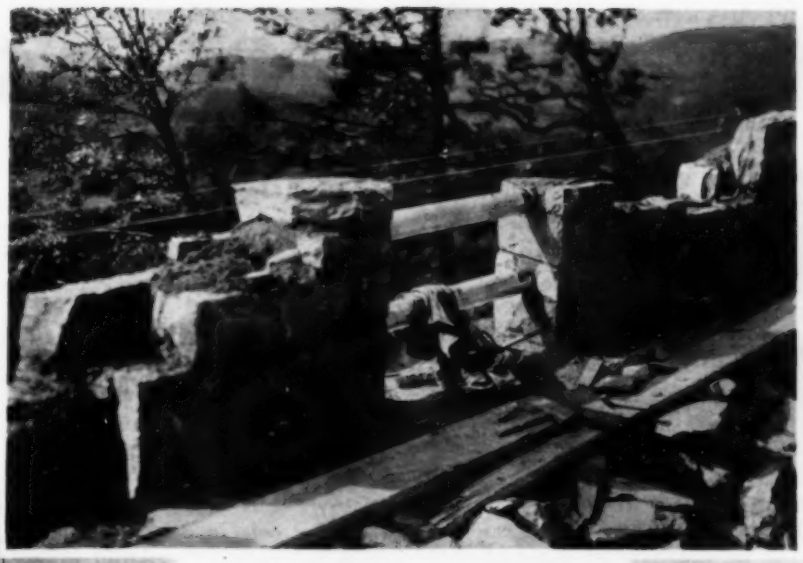
Masonry Walls—Construction of retaining walls and parapet walls 18 in. wide was carried on simultaneously with the grading of the mountain section, nearly all the walls being built before the grading was completed. This procedure was possible because the engineers had determined the final location of both the highway and the wall before construction began, and no changes in location were made after the contractor had started operations.

According to the design, the top of the retaining wall, 2 ft. wide, parallels in elevation the outer edge of the pavement. The depth of the retaining wall varies up to a maximum of 33 ft. For depths of 14 ft. or less, the wall has a batter of 1 in 6 on the outside face, and 1 in 3 on the inside. Walls of greater depth have an increased inside batter to give a base width equal to two-thirds of the height. Actually, the volume of the deeper walls was greatly diminished by incorporating natural rock. When employing this construction, the masonry veneer never was less than one-third of the height of wall. Stones up to 7 cu.yd. in size were placed in the heavy wall sections, and a 1:3 cement-sand mortar was used in laying up the retaining walls.

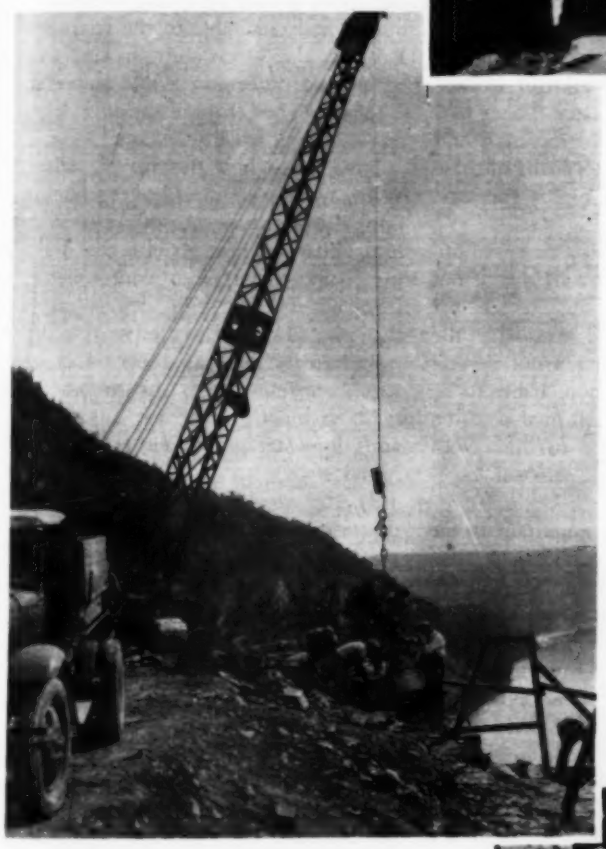
To improve the appearance of the parapet wall and eliminate the possibility of having retaining wall stones protrude into the concrete gutter of the highway, the engineer on the project lowered the top of the retaining wall 6 in. and carried up the parapet wall from this elevation. The parapet wall was designed 30 in. high by 18 in. wide, without any coping, but the altered procedure of carrying up the parapet wall from the lower elevation increased the actual construction height to 36 in. A 1:3 mortar was used to within 2½ in. of the top, and a 1:2 mortar above this point, to provide greater strength for weathering. The joints at the top of the wall were raked out and brushed with a wire brush to remove the gloss. This design produced a substantial guard wall characterized by simplicity, good proportions, and pleasing appearance.

Excavation — Sidehill cuts in the mountain section of the project and through cuts at the two ends of the project required the removal of about 240,000 yd. of material, of which 40 per cent was rock. Only one-third of the spoil was needed for fills, and the rest was wasted. The heaviest cut entailed the excavation of 69,000 yd. of gravel in ½ mi. Most of the spoil was moved by trucks.

In the rock cuts and at the quarry, the contractor carried on drilling operations with six Ingersoll-Rand drifters, six Ingersoll-Rand jackhamers, and one Gardner-Denver hand-hammer drill, supplied with air by five Ingersoll-Rand 310-cu.ft. air compressors. The drifter drills were mounted on tripods. Both the deep cuts and the quarry were drilled and blasted by the benching method, using horizontal as well as vertical holes where conditions made them advantageous. The deepest holes measured 16 ft. long. The usual practice was to start these holes with 1¼-in. steel and finish with 1-in. steel. Most of the blasts were made with Hercules or DuPont 40-per cent gelatin dynamite, although 60-per cent dynamite was used in the back holes of heavy overhanging



SNOW OPENING in parapet wall is protected by two 4-in. galvanized pipes anchored in stone masonry.



CRAWLER CRANE *(left)* places quarry stone in masonry retaining wall.

CHAIN SLING *(right)* from single crane hoist line is used to set smaller stones as retaining wall approaches final elevation.

DRIFTER DRILL on tripod sinks inclined hole in overhanging shattered rock above highway.

FRAMED BATTER BOARDS set up on rock foundation guide masons in building stone retaining wall. Highway opens scenic vistas to tourist.

rock cuts, and 30-per cent dynamite in the retaining wall footings, to avoid shattering the sound natural rock.

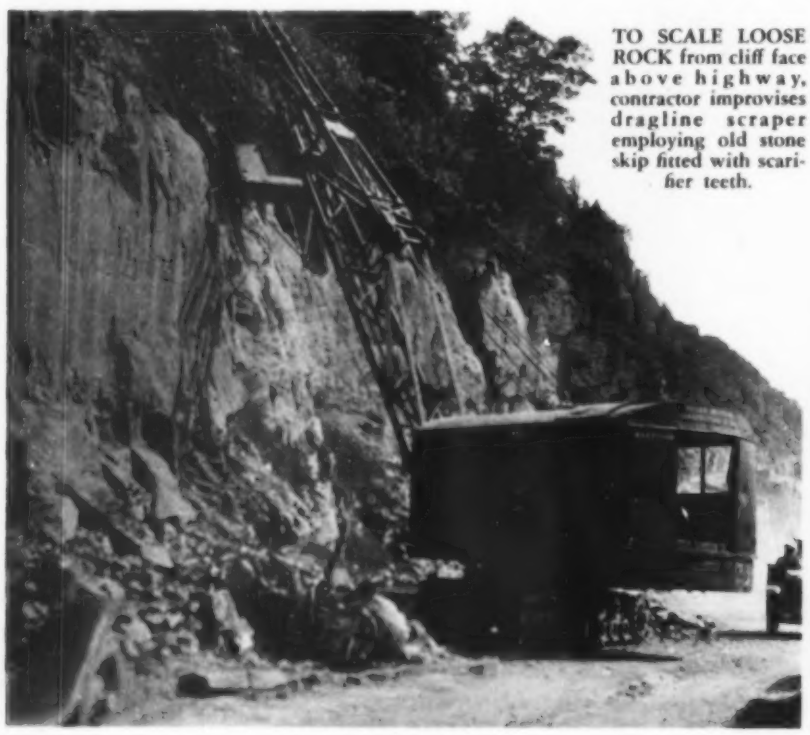
It had been expected that excavation for the highway would produce rock satisfactory for construction of the wall. The excavated rock, however, proved to be a disintegrated sandstone of inferior quality, and the contractor was forced to look elsewhere for wall stone. Fortunately, a ledge of sound blue sandstone was discovered along the right-of-way in the mountain section, and the contractor produced all the wall stone from a quarry opened at this point.

Five excavating machines, of ½- to 1½-yd. capacity, were used alternately for earth grading, loading broken rock, and setting stone in the wall. These power excavators, a Lima, a P&H, a Universal and two Thew-Lorains, were equipped as shovels or as cranes to carry on different kinds of work. One of the two Thew-Lorains was rigged for part of the time as a back-digger to trim side slopes and cut ditches along the earth sections of the project.

Wall Construction — Rock foundations of the retaining wall were trimmed and washed down to afford a clean, level base for the masonry. In walls of great depth, the base often was leveled up by placing concrete footings on irregular rock surfaces with 1¼-in. steel dowels cast in the concrete. This concrete, as well as the concrete for the two bridges, was mixed by a 1-yd. paver stationed at the location of the permanent batching plant and was delivered by a 1½-yd. Jaeger truck-mixer.

Openings were left at intervals in the parapet walls to facilitate removal of snow from the highway. Two bars of 4-in. galvanized pipe were cast in the wall across each of these openings, as indicated by one of the photographs. One end of each pipe was covered by a sleeve wrapping to permit expansion of the metal to take place without damage to the wall.

Direction — Operations began on May 2, and wall construction and grading were completed, ready for paving, early in September. A. C. Sternberg, president, was in charge of the work for the Miller Bros. Construction Co., assisted by A. C. Sternberg, Jr. For the New York State Department of Public Works, under J. S. Bixby, district engineer at Poughkeepsie, H. .H. Feldmann was resident engineer in charge of location and construction. Col. Frederick Stuart Greene is superintendent of the State Department of Public Works, and Arthur W. Brandt is commissioner of highways.



TO SCALE LOOSE ROCK from cliff face above highway, contractor improvises dragline scraper employing old stone skip fitted with scarifier teeth.

Functions of the

An Address before the Construction Division, American Society of Civil Engineers

AT THE CONVENTION of this society in 1932 I took the opportunity to set forth some of my views on the relations between contractors and engineers. This is at present the no-man's-land of the construction industry. It is filled with problems which are only indistinctly seen, but which are frequently fruitful in discord, waste and inefficiency. To say that both engineering and contracting would not benefit by a thorough airing of these problems is to take a highly romantic view of the situation.

We are not attempting to prove opposite sides of a case; we are met, if not to find a solution, at least to see just where the problem lies. And when the problem is approached from several points of view it is more liable to be located. Finally, an informal occasion of this sort allows me to draw with more freedom on my personal experience.

This is particularly important to me because on various occasions I have been at the same time on several distinct jobs—an engineer on one and a contractor on the other. I see both sides of the question only too well. Indeed, it was my personal dual experience which brought me to think seriously of engineer-contractor relationships in the first place, and has convinced me that they can and should be placed on a more satisfactory basis.

Aggregate Specification

I well remember one contract in which I was involved. The specifications called for the use of concrete containing a coarse aggregate of 1-in. maximum diameter. That was down in black and white. One and one-quarter inch aggregate was available and I, as contractor, to save time and expense, wanted to use this as a substitute. The young field engineer replied by pointing to the specifications. These called for 1-in. aggregate, and 1-in. aggregate he proposed to have. So we rescreened and recrushed our rock and finally got it down to the specified size, after considerable delay and additional expense. The work is no better today for our pains. I was acting at the same time as consulting engineer on another piece of construction of similar character. A few days after the experience with the 1-in. aggregate my own field engineer came to me with the news that our contractor wanted to use 2½-in. aggregate instead of the 2-in. aggregate specified. I could not in the exercise of honest judgment refuse the concession.

Small matters, perhaps; but it is such conflicts as these, which need not be conflicts at all in two cases out of three, that frequently spell the difference between a job that is unnecessarily costly and sometimes inferior in quality, and one which is both profitable to the contractor and creditable to the engineer. I daresay that a few shifts in emphasis within the profession would suffice to eliminate a good share of the difficulties.

Young Engineers

Now, as to how this trouble arises. When a young engineer leaves school in normal times, two courses are open to him. First, he may go into the drawing room—that is, into work which is involved directly with design rather than execution. Second, he may go directly into the field, as inspector, or instrumentman—that is, he becomes a field engineer. There are advantages and disadvantages in either of these initial steps.

If the young engineer enters the drafting room and engages in the designing end of engineering, he is able, in the shortest possible time, to put into use the results of his studies. He finds immediate and direct application for the theory and the technical knowledge which he has spent at least four years in absorbing. The drawback is, of course, that he may fail to realize the distinction between theory and reality. He finds it hard to understand that field difficulties can frequently nullify the best executed design. He sees his plans not as something which must be executed, but as a finished product which the contractor, by some secret magic of his own, must bring into being. To be blunt about it, the designer with inadequate experience in construction problems, tends to become a literal-minded hair-splitter who is irritated whenever the construction fails to look like the picture he has drawn.

I recall some plans for raising by several feet the level of a viaduct. The plans called for placing enormous castings between the supporting piers and the end bearings of the viaduct trusses. Obviously the designer had not given the slightest thought to the problem of getting these huge castings in place. He demanded an impossibility under the limitation of clearance and the plans had to be re-drawn.

Suppose, on the other hand, that the young engineer goes first into field work, rightly believing that he cannot become an all-round engineer until he has had some experience of it, and expects to go back from field work into office work again. He has a more exciting time of it, perhaps. But when

Construction Engineer

By HERBERT S. CROCKER

Past-President, American Society of Civil Engineers

he does finally turn to the office, he is at a temporary disadvantage when he has to deal with questions of design. Field work makes comparatively litttle call on the young engineer's newly-acquired technical knowledge, and he is apt to grow rusty.

Field or Office

Whether experience begins in office or in field depends largely upon whatever opening first presents itself. I believe, however, that we all agree that the fullest measure of financial success and professional reputation comes to the engineer with both kinds of experience, provided he is gifted with sound judgment and possesses that rare qualification of the ability to handle men. In any just analysis of the engineer's duties, the field responsibilities are every bit as important as the responsibility for correct design.

Consider the relation between engineer and owner, or client. The engineer must first make plans to suit the owner's requirements. They are accepted. Then come bids, and with these the engineer assumes a wholly different role—that of arbitrator between owner and contractor. In the contract between owner and contractor it is stipulated that the engineer's plans shall be followed, and that in case of dispute the engineer is to be sole arbitrator, with judgment final and binding.

It may be doubted whether such a stipulation is legally defensible. The engineer is the paid employee of one of the parties, the owner. But the idea behind it is reasonable enough. It is based on the superior technical knowledge of the engineer. Fortunately this theory does not always fit the facts these days. The day of the rough and ready practical contractor on important work is drawing to a close; I hold no brief for him. He is being superseded by the contractor who realizes the value of an engineering staff of his own, and in fact finds such a staff necessary because of the more elaborate and technical nature of much modern construction work. Many a designer whose plans call for, say, an intricate outline of reinforced concrete, would be stumped if he had to design the forms in which this concrete work is poured. Frequently the contractor must solve engineering problems which have never occurred to the designer and with which he would probably be unable to cope.

In view of this, it is no longer possible to assume the invariable superiority of the engineer. The situation is made even worse, practically, by the current emphasis upon design rather than upon the construction side of the engineer's work. For what that means is that while the contractor is constantly improving his technique, the quality of the engineer's field men is tending to deteriorate. More and more, the engineer's field work is being turned over to the untrained and the inexperienced.

Purpose and Plans

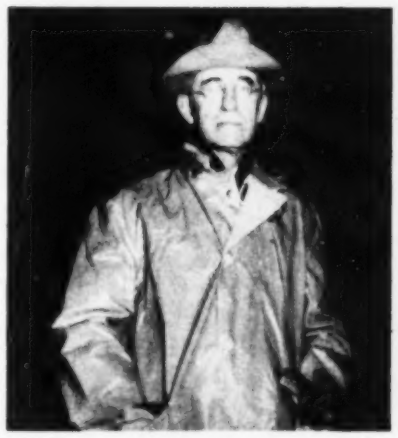
The really competent field man knows that a plan is merely something to shoot at—an ideal which it would be highly gratifying to achieve, but which nine times out of ten he will fall short of. A plan, to him, is something which constantly calls for compromise. He can, and does, frequently waive requirements in plans, to the benefit of both contractor and owner. The untrained or incompetent field man takes his plans literally. He is like the man who believes everything he sees in print. He is the young engineer who gets the aggregate down to the fraction of an inch, though the contractor go bankrupt in the process. He will cause a row of concrete piles, whose heads will be imbedded in a concrete foundation anyway, to be chipped off to exact level. If the drawing shows precise and beautiful curves where the bridge joins the land, he will force the contractor to execute those curves with meticulous care, though eventually they are intended to be covered with dirt. He is, to be brief, a nuisance, interested mainly in achieving the impossible, and the principal cause of most contractors' grey hairs, even as the contractor is responsible for many a white-headed engineer.

Occasionally a field man will go even farther than this, and start off with the assumption that the contractor is some one to "get". He feels that he hasn't really done justice to the owner until he has thrown every obstacle he can think of in the path of the contractor, and his notion of the highest virtue is, apparently, to wear out as many contractors as possible. The beauty of it, from his point of view, is that the cards are all stacked for him. In writing the contract the engineer is not content merely to make specific provisions; he adds a sort of blanket, clean-up clause, a sop to absorb all the remaining gravy, to the effect that the contractor has to do a good job generally—"all work must be performed to the satisfaction of the engineer". The contractor hesitates to challenge this. After all, he is in the contracting business, he hopes for future business, and frequently he takes a loss rather than risk the reputation of being a kicker. In consequence the sorest point of contractor-engineer relationships—that of incompetent field work—seldom comes to a head.

It is perhaps not possible to work out the waste involved in this, in dollars and cents. Yet it is unquestionably a huge burden on the construction industry as a whole. On the one hand, there are the losses sustained by contractors who must put up with incompetent field men. On the other hand, there is the added cost to the owner which is forced on him by contractors who often find it wise to include in their estimates an allowance to cover expenses arising from this source.

Theory vs Practice

Lest this begin to seem like a straight-out denunciation of field engineers, I hasten to say that it is frequently not the field engineer's fault. A large pro-



HERBERT S. CROCKER

portion of the field inspectors are young and inexperienced men, who have hardly more than an inkling of the nature of the practical problems which they must face. While in college they have to devote most of their attention to the elements of engineering education which cannot be attained except by study. They must concentrate on the theoretical elements. And as the technical side of engineering grows more and more complicated, the engineering schools must devote more and more time to the purely technical side, to the still further neglect of the practical. Consequently, little time is left in engineering school to devote to the field side of the work, which, by tradition, is left to the university of hard knocks. But though the colleges can hardly be expected to turn out students with practical experience, at least, it seems to me, they owe it to their students to provide some notion as to the nature of the problems they will have to solve when they are thrown out into the field.

The father of a young engineer, in the employ of a contractor as a superintendent, told me a story recently which illustrates the present haphazard ways of acquiring field experience. The work called for placing a large piece of machinery on a high tower. The young engineer couldn't see how he could ever put that piece of machinery up there. He worried a good deal about it. But finally he ceased worrying. Some one asked him why he had stopped worrying.

"Well," he said, "when the time comes I'll just tell my foreman to put it up and then I'll go to town for the mail".

If he was a wise young man he hid behind a tree, on his way for the mail, and from that vantage point got a practical lesson in construction methods. But an education which must be gleaned from behind trees has its flaws. I am convinced that somewhat more emphasis in the colleges on construction methods, on the limits of compromise in the field and so on, would be well worth while. It would hardly provide the student with a mature and balanced judgment, but at least it would make the achieving of such judgment somewhat easier.

Yet even that would fail to contribute much to relieve the difficulty unless it were coupled with something else—an improvement of the status of the field man within the profession. At present he is definitely underpaid, and he is not encouraged to take responsibility into his own hands. When called upon to make a decision in the field he finds it easer and safer to fall back on the letter of the plan, even when good sense and justice to both owner and contractor demand that the plan be modified somewhat. More than one field engineer has suffered at the hands of his superiors because he has ventured to take the initiative.

Initiative and a sense of responsibility, coupled wth experience and good judgment, are the most valuable qualities that a field man can have. We all know this, and we all deplore the fact that these qualities are more rare in the field than they should be—without doing anything about it. To my mind the answer to the question lies in the inclusion in college curricula of courses in the technique of construction machinery and its uses, as well as studies of field methods of erection and handling of materials in an economical manner. The state of the art has reached the point where inexperienced men cannot safely be intrusted with the making of important field decisions. They cannot be allowed to gain experience through their mistakes. Therefore a field organization on work of any magnitude should be headed by at least one thoroughly experienced engineer under whose supervision the younger men may gain their experience. If we could all take some measures to put these reforms into effect, then I am sure there would soon be no need for listening to any more speeches like this.

Heavy-Duty Road to Serve Norris Dam a RUSH JOB

WORKING FOUR 5½-hour shifts 7 days a week the W. W. Boxley Co., of Roanoke, Va., has made exceptional progress in building the 4.8-mi. heavy-duty concrete highway that will provide the transportation connection between the railhead and the $34,000,000 Norris Dam project of the Tennessee Valley authority.

Located on low grades and easy curves, this road is being surfaced with a 22-ft. width of 10-8-10-in. reinforced concrete to carry the heavy loads of construction materials and machinery for the dam that will be moved over it. Unusual speed in grading and pouring was forced by the necessity of providing all-weather means of reaching the damsite at the earliest possible moment. Hence, the contract required the job to be completed in 69 working days. When these notes were prepared William Bray, in charge for the contractor, was well ahead of schedule.

The location passes through a rugged, mountain country that had to be hit hard to get the low grades and easy curves adopted. About 200,000 yd. of earth and rock had to be moved, averaging more than 40,000 yd. to the mile. Much of this grading is balanced cuts and fills, but quite a bit of the heaviest cuts is side-casting.

Six large power shovels have been spotted at intervals along the job. Where cuts and fills are fairly balanced the shovel spoil is loaded into motor trucks for delivery to the cuts. On side-casting the larger shovels are used to shape up the 30-ft. finished grade. Caterpillar bulldozers are used wherever practical.

General plans provide first for the completion of an 11-ft. strip of paving the length of the job in order to get through transportation service at the earliest possible moment. The second 11-ft. strip will then be completed.

Fine grading for the first paving strip is done with a subgrader, with some close hand-dressing. At times when the concrete placing outfit caught up with the main grading it dropped back to work on the second paving strip.

Concrete materials are delivered at the railhead end of the road. Stone and sand are unloaded from the cars by a crane that is large enough to keep good-sized stock piles ahead. No chance is taken on rail shipments arriving exactly as needed.

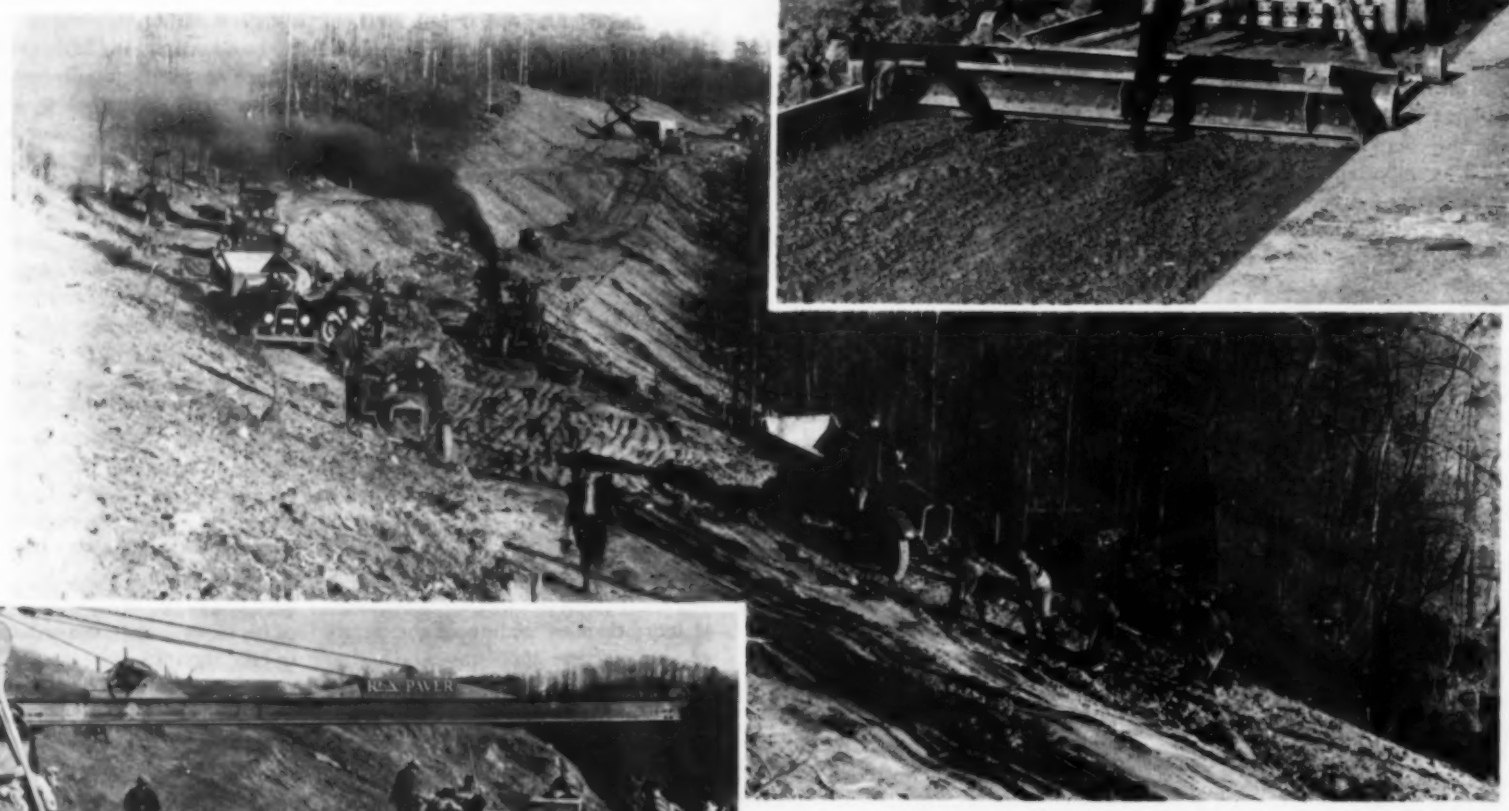
Trucks move proportioned concrete batches from a plant at the railhead to the Rex paving mixer. The latter works at one side on the first 11-ft. strip, so form-setting, subgrade work and fine grading may proceed without truck interference.

Finishing is done by an Ord machine. When temperatures are low, lighted oil lanterns under tarpaulins on frames provide all the heat necessary to keep the concrete warm enough. At other times the usual open-air curing methods are used.

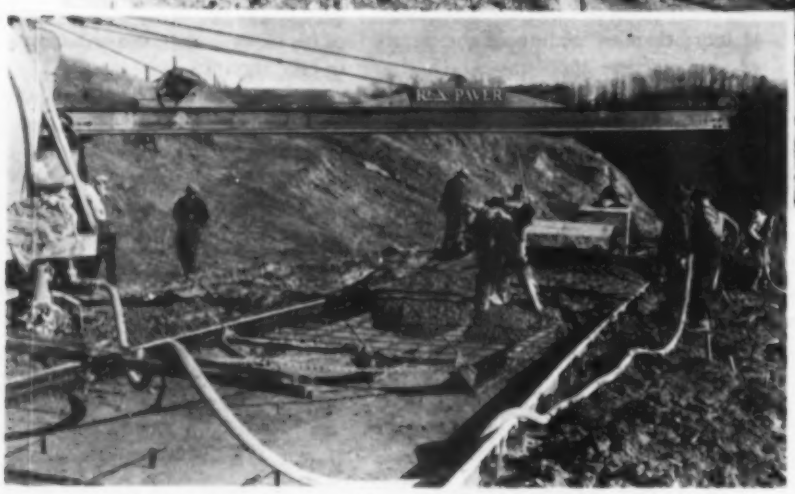
Quite a bit of the concrete will be laid on green fills. The risk of the slab cracking, due to settlement of these fills, has been recognized. A level party will check constantly on the road after it is opened to determine settlement as fast as it starts. Where necessary, mud will be pumped under the slab to maintain its support.

A. E. Morgan, chairman of the Tennessee Valley Authority, is in charge of all construction operations. C. H. Locher is construction consultant of the Authority. B. M. Jones is construction engineer and Ross White is construction superintendent on the Norris Dam. J. W. Bradner, Jr. is in direct charge of the heavy-duty highway job for the Authority.

SUBGRADER *(right)* shapes base for second 11-ft. strip of 22-ft. wide road. Flat wheels run on finished slab and flanged wheels on form.



HEAVY GRADING through rugged, mountain country requires moving of 200,000 yd. of earth and rock for 4.8-mi. long road.



PAVING MIXER works along outside of 11-ft. strip, leaving subgrade free from trucking. Reinforcement is positioned with aid of steel "sled" drawn by mixer.

JOB ODDITIES

A Monthly Page of Unusual Features of Construction

EARTHQUAKE PROOF VAULT of reinforced concrete, built by Los Angeles County, Calif., provides safe repository for one copy of all notes and maps of public surveys and records of the location of 81,311 service connections. Under the direction of J. E. Rockhold, county surveyor, the vault was constructed in San Fernando Valley, 20 mi. northeast of Los Angeles, on a site free from the hazards of fire, flood and falling buildings. The structure has reinforced concrete walls 1 ft. thick and measures 28x32 ft. inside; the roof and floor, also of concrete, are both 4 in. thick. In the design, resistance to earthquake damage, constant temperature and freedom from moisture were the main considerations.

DOUBLE HEADER. Two 4-cu.yd. Rex agitator bodies, filled with concrete from high-level mixing plant, are picked up from truck chassis in one load by construction cableway at Boulder Dam. This system of delivery is employed by Six Companies Inc. for spillway lining operations.

RAILROAD VIADUCT THROUGH BUILDING. Elevated structure of New York Central to remove tracks from street along Hudson River, New York City, pierces Bell Telephone Laboratories. To prevent vibration, viaduct has independent foundations carried down 60 to 80 ft. to rock and insulated by lead and asbestos pads. Contractor, John Lowry, Inc.

PROTECTED AGAINST OVERHEATING. Built-in disk thermostat control device prevents damage to Westinghouse industrial motors when overload causes temperature of insulation to reach danger point.

If You Want Further Information—

Within the space limits of this page it is impossible to present complete information about the products illustrated.

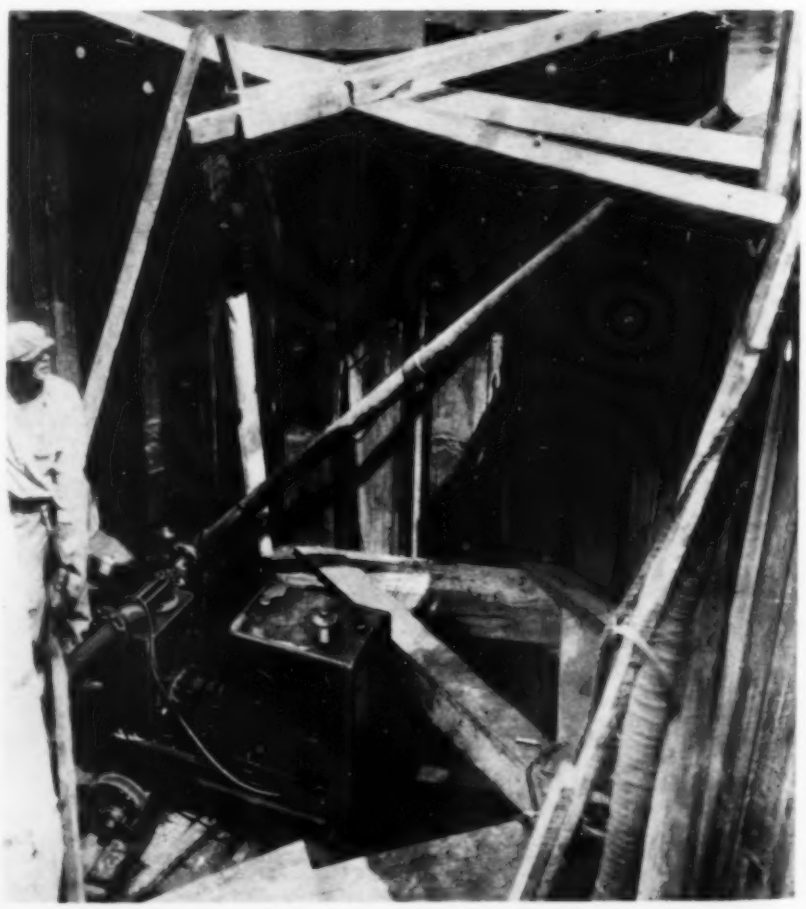
The manufacturers, however, will be glad to supply further details if you will write to them.

NEW EQUIPMENT *on the Job*

HYDRAULICALLY CONTROLLED ELEVATOR AND PLOW, 42- and 48-in. engine-driven belts, and extensible rear axles provide greater flexibility and increased capacity output for contractor's elevating grader. Hydraulic controls raise plow and elevator and hold them rigidly in any position. Rotary oil pump which actuates operating rams rotates constantly but develops pressure only when plow or elevator is raised. Cross-over drive chain prevents injury to operator and machine. Carrier equipped with anti-friction bearings throughout and provided with automatic spiral pan cleaner. 48-in. machine provided with extensible rear axle which can be extended 18 in. to increase stability of machine.—Austin-Western Road Machinery Co., 400 N. Michigan Blvd., Chicago.

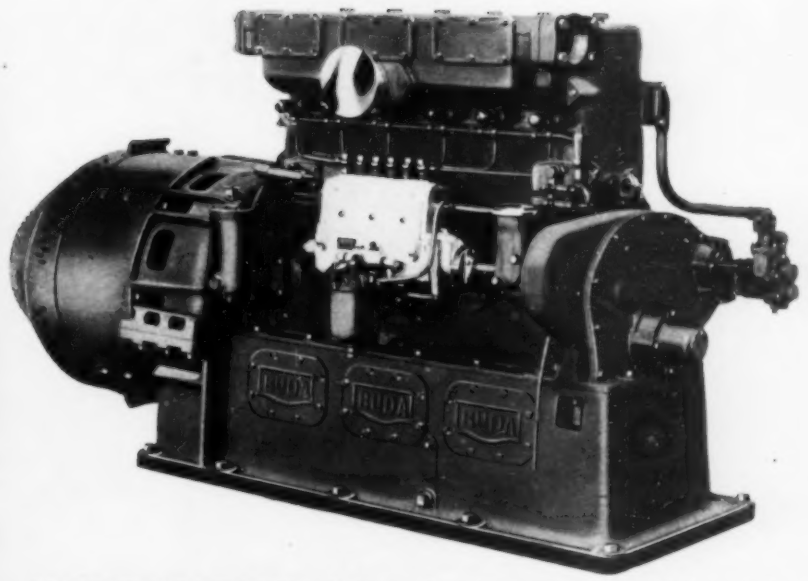
THREE-POINT MASONRY DRILL *(left)* permits resharpening on any grinding wheel right on job and will drill holes until worn down to shank. Straight parallel sides of cutting lips insure accurate holes. Drill breakage reduced to minimum. Hand-forged from best quality tool steel. Heat-treated and tempered. Made in sizes ⅜- to 1⅛-in. diameter, in different lengths, for both hand and power drilling. — Rawlplug Co., Inc., 98 Lafayette St., New York City.

FOR WELDING CAST IRON, electrode *(below)*, called "Ferroweld", produces weld of great strength and ductility. Has steel core surrounded by heavy, flux coating which protects arc from gases injurious to weld. Can be used with low heat, thus reducing possibility of cracking. Electrode manufactured in ⅛-in. size and used with approximately 80 amp. of current. Welding done intermittently, a bead of not more than 3 in. being laid down at one time. As each bead is welded it is peened slightly, cleaned and cooled before next bead is deposited. Views show weld made on punch press ram with Ferroweld.—The Lincoln Electric Co., Cleveland, Ohio.



FASTER PRIME AND HIGHER HEAD are produced in this latest model centrifugal pump by "Injecto Prime" principle by which air is injected into recirculating water flowing at high velocity, thus exhausting the air more rapidly from the suction line. Designed with two moving parts—impeller and impeller shaft — and has no valves, floats, adjustments or packing glands. Built in four sizes, 2, 3, 4 and 6 in., pumping 10,000, 20,000, 40,000 and 90,000 g.p.h. respectively.—Novo Engine Co., Lansing, Mich.

MUD JACK for correcting sunken concrete slab raises to original grade concrete curb, gutter, walks and streets as well as floors of filling stations and factories. Unit equipped with 2½-in. nozzle pumps 20:1 mixture of black top soil and cement at pressure of 100 lb. per square inch through holes drilled in pavement filling voids and raising slab to proper grade. Equipped with 1¼-hp. air-cooled engine with normal capacity of 1¼ cu.yd. per hour. Weighs less than 400 lb. and can be moved about by one man.—National Equipment Corp., N. 30th St. and W. Concordia Ave., Milwaukee, Wis.

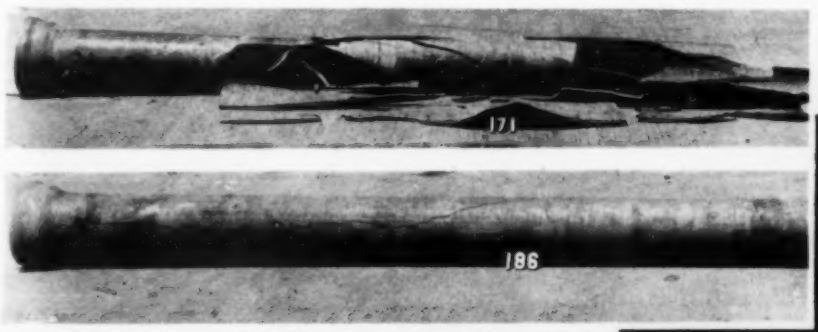


LOW COST ELECTRICITY made possible by light, compact six-cylinder diesel generating set which will produce current at approximately ¾ to 1 c. per kilowatt-hour. These sets range in size from 10 to 90 kw. a.c. or d.c., and do not require continuous services of attendant, two or three inspections daily being sufficient. Capable of 24-hr. service. No compressor needed, as fuel is injected into cylinders without aid of compressed air. Electric starting equipment is provided. Governor, as well as manual regulator, control speed to maintain constant voltage despite load variations.—The Buda Co., General Offices and Works, Harvey, Ill.

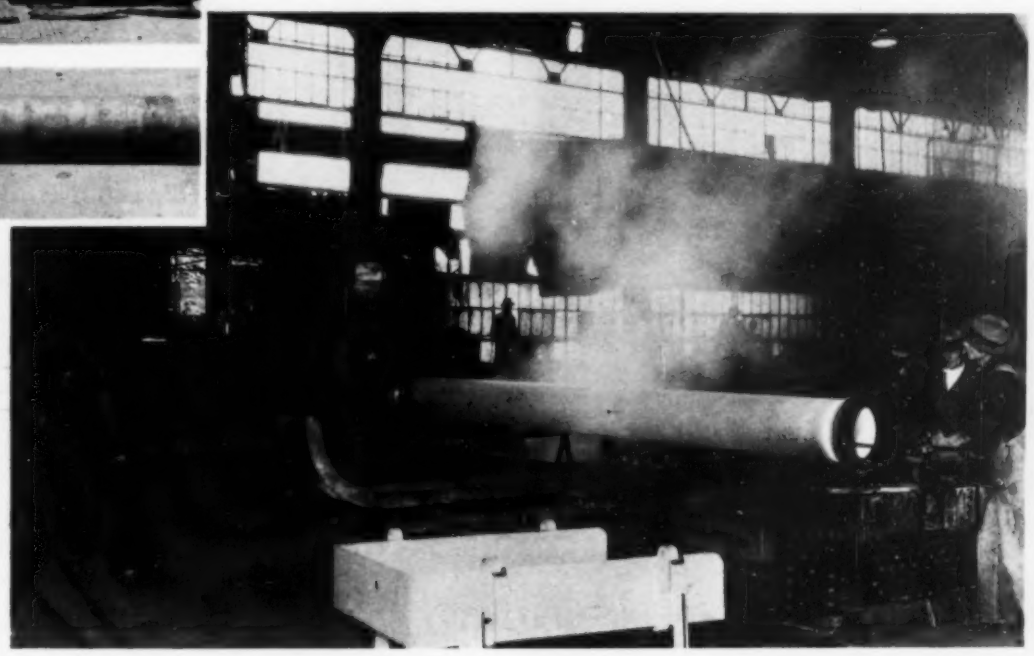
CRACK AND JOINT FILLER fills breaks and openings in concrete pavement rapidly, cleanly and economically. Boiler holding 8 gal. of filler and needle feeding material into crack are both swivel-mounted on ball bearings, enabling needle to swing through radius of 40 in. Needle placed in crack will follow break without guidance. Hot flame supplied by gasoline from 1½-gal. fuel tank. Fully loaded, device weighs less than 100 lb. Flow of material controlled by hand throttle. Feed line to needle heated by hot air forced through tube housing. One operator easily fills 1 mi. of ¾-in. pavement joint (½ to ¾ in. deep) in 1 day. Eliminates waste of material.—R. C. Burket Co., 1920 West Norwegian St., Pottsville, Pa.

IMPACT RESISTANT CAST-IRON PIPE—As the result of two years of research at the laboratories of the United States Pipe & Foundry Co., at Burlington, N. J., a radical improvement, increasing resistance to impact and thereby minimizing breakage in shipping, handling and distribution on the job, has been introduced in the manufacture of cast-iron pipe by the deLavaud centrifugal process. By blowing a thin, insulating film of powdered ferro-silicon on the surface of the revolving water-cooled metal mold, just before contact with the stream of molten metal, it has been found possible to prevent chill in the exterior portion of the pipe wall, thereby producing a tougher, more ductile metal than was possible with the standard deLavaud process previously employed. This prevention of chill by the insulating film of powdered silicon allows the metal, after proper annealing, to attain a "dendrite" or interlocking crystalline structure, which makes the finished pipe twice as resistant to damage by impact as heretofore. Other advantages are greatly increased machineability and ease of cutting or tapping.

The silicon powder is applied to the mold uniformly in an atomized state by compressed air through a special taper-bore, perforated nozzle, attached just ahead of the discharge end of the channel which carries the molten iron into the revolving mold. The product of the improved process is called Super-deLavaud pipe; it is made in diameters of from 3 to 24 in. and in lengths of 12 and 18 ft.—United States Pipe & Foundry Co., Burlington, N. J.



TESTED TO FAILURE by internal water pressure standard 8-in. pipe *(top)* shows complete fragmentation, while tougher Super-de Lavaud pipe *(bottom)* shows cracks without complete rupture.

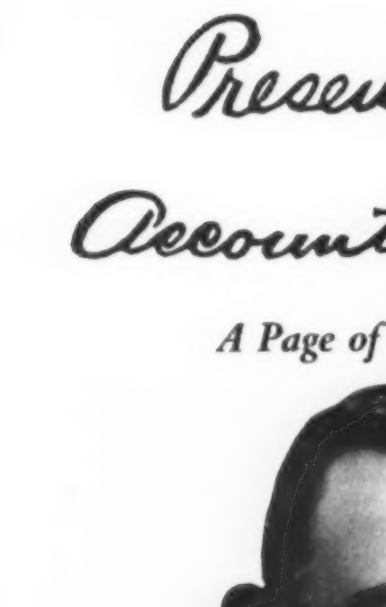


CENTRIFUGAL CASTING *(right)* is done in revolving mold in moving carriage.

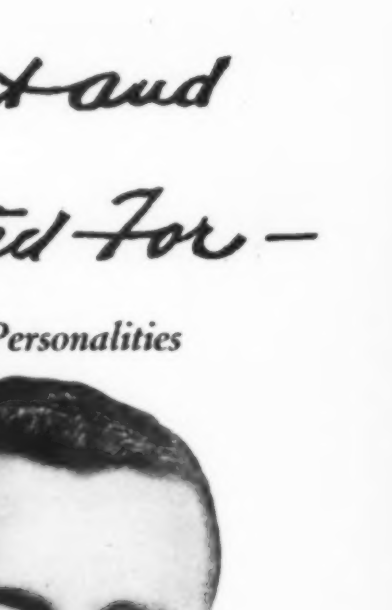
Present and Accounted For —

A Page of Personalities

JOHN F. COLEMAN, consulting engineer, of New Orleans, La., and past-president of the American Society of Civil Engineers, was elected president of the American Engineering Council at its annual meeting in Washington, D. C. last month. He succeeds W. S. Lee, of Charlotte, N. C.



HOWARD A. GRAY has been appointed by Administrator Harold L. Ickes to become director of the Division of Inspection of the Federal Emergency Administration of Public Works. The division is charged with responsibility for checking work done under P.W.A. loans and grants for non-federal construction.



A. W. MERCHANT, of Providence, R. I., president of the contracting firm of A. W. Merchant, Inc., has been elected national vice-president-at-large of the Associated General Contractors of America.

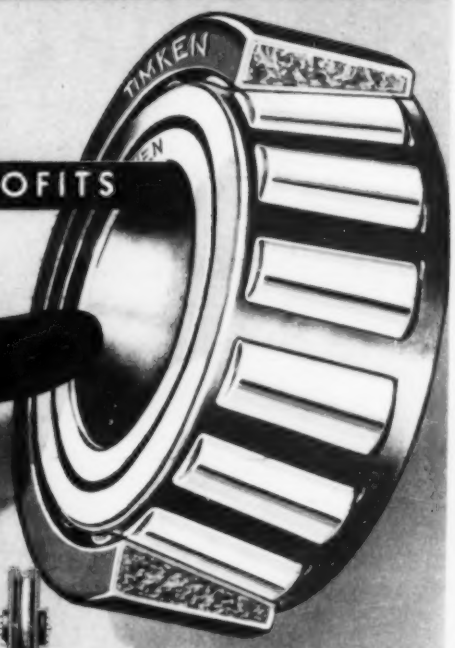
N. F. HELMERS, of St. Paul, Minn., is the newly elected president of the Associated General Contractors of America, which held its annual meeting in Washington last month. Mr. Helmers heads the contracting firm of Siems-Helmers, Inc., which is now building the substructure for the Mississippi River bridge at New Orleans, La.

DANIEL J. KEATING, partner in the firm of Harry W. Patterson, of Buffalo, N. Y., has been chosen president of the New York State Highway Chapter of the Associated General Contractors of America. Mr. Keating, a charter member of the association, has served as its vice-president and as chairman of its Committee on Specifications.

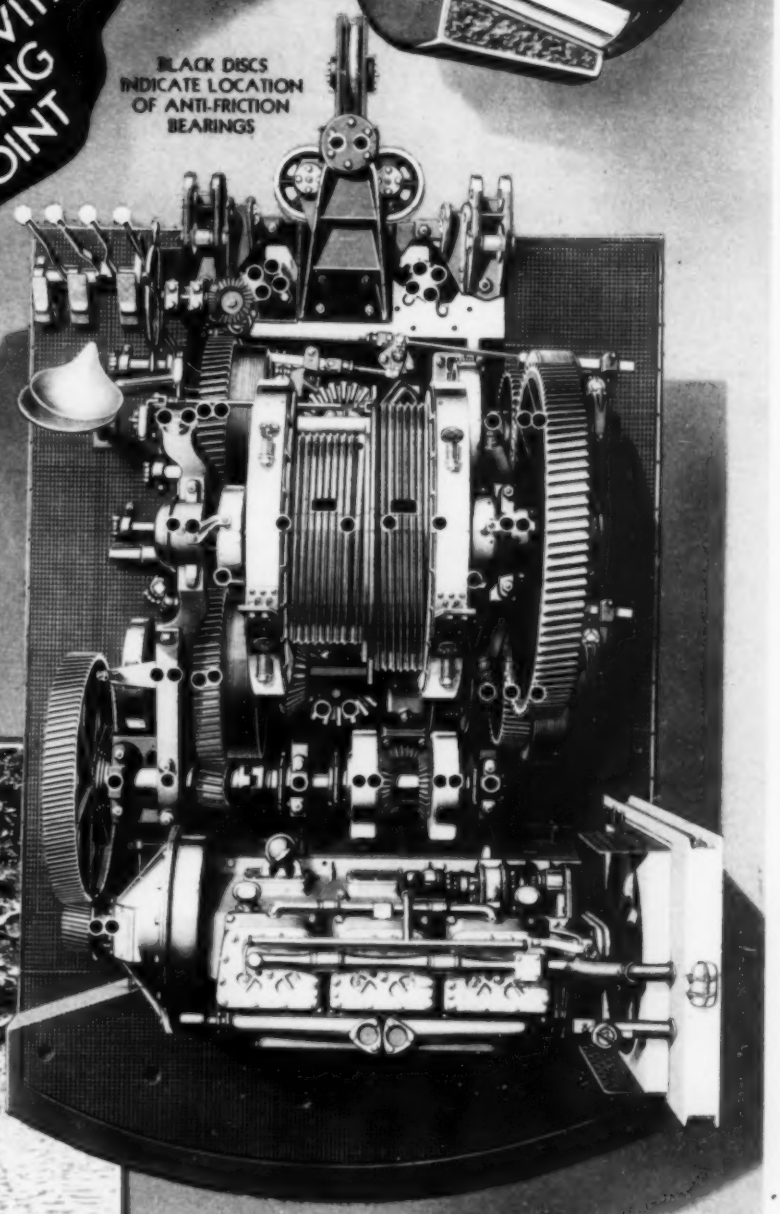
Lima FEATURES
POINT TO GREATER PROFITS

AN EXCLUSIVE LIMA FEATURE

ROLLER BEARINGS AT EVERY VITAL BEARING POINT



BLACK DISCS INDICATE LOCATION OF ANTI-FRICTION BEARINGS



THE great number of roller bearings which are used in LIMA excavators not only conserve power and lengthen the life of the machine, but they also lower maintenance cost by guarding against improper tooth action, destructive chattering and grabbing clutches and annoying end play in the cone rollers and bevel gears.

LIMAS are the most modern and efficient excavators on the market---their distinctive features point to greater profits.

THE OHIO POWER SHOVEL CO., LIMA, OHIO, U.S.A.

Division Lima Locomotive Works, Incorporated

SEATTLE 8244 First Ave. So. | CHICAGO 1543 Steger Bldg. | NEW YORK 143d Street and Bridgeport Avenue | NEWARK, N.J. 317 Frelinghuysen Avenue | DALLAS 1201 So. Lamar St

The General Supply Co. of Canada, Ltd. Ottawa, Ont. | MONTREAL 77 McGill Street | Tees Machinery Corp., Ltd. Vancouver, B. C.

SHOVELS
DRAGLINES
CRANES
BACKDIGGERS

LIMA

¾ YARD
1 YARD
1¼ YARD
1½ YARD
1¾ YARD
CAPACITIES

TYPES 302 · 404 · 502 · 601 · 701

One of six "Caterpillar" Diesel Seventy-Fives that slashed costs for A. Guthrie and Co. on the Mississippi Levee, averaging 1000 yds. per tractor per day on hauls from 1000 feet up.

"I'M CONVERTED

to the 'CATERPILLAR' DIESEL" . . . says a Southern California contractor — and no wonder, with a fuel saving better than $150 a month.

It is *economy* that has put hundreds of "Caterpillar" Diesel Tractors to work on outdoor jobs everywhere. Economy of low-priced Diesel fuels. Economy of low fuel consumption.

Economy and power and sturdy dependability and simplicity of design.

"Caterpillar" Diesel Tractors are built in three sizes, and the engines that power them are available also for stationary and portable uses. Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

▲ Carving a new road out of the mountainside in the Santa Barbara National Forest, this "Caterpillar" Diesel Fifty uses only 60c worth of fuel per 8-hour shift.

▶ At 11,000-foot altitude near Aspen, Colorado, this "Caterpillar" Diesel Fifty is saving power costs in the construction of a diversion tunnel.

YOUR LINE IS LEAKING AIR!

NEVER MIND, OLD TOP—REX SPEED PRIME PUMPS CAN TAKE IT!

Rex Speed Prime Pumps have the extra air handling capacity to handle water containing air in quantities that will stop any other centrifugal. Here are the reasons why. The patented "peeler," a steel blade set close to the impeller's path, actually cuts the air away from the impeller and rushes it out of the system . . . either when the pump is priming or when the suction line is leaking air. It is found only on Rex Speed Prime Pumps. The Recirculation Cut-off stops the recirculation of water once the prime is established . . . saving power and maintaining the full capacity of the pump. If the prime is lost . . . the Rex Prime control automatically reprimes these pumps. They keep right on pumping when others stop.

REX 2" SPEED PRIME PUMP 10,000 g.p.h.

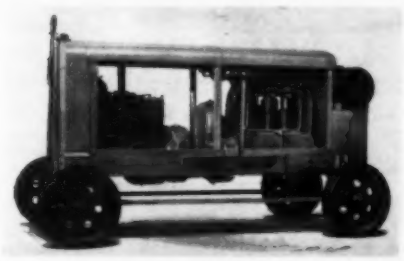
REX 3" SPEED PRIME PUMP 20,000 g.p.h.

REX 4" SPEED PRIME PUMP 40,000 g.p.h.

REX 6" SPEED PRIME PUMP 90,000 g.p.h.

If you do dewatering, contracting, bridge, utility or industrial jobs . . . you need Rex Speed Prime Pumps. Mail the coupon for Catalog No. 240.

Below—The Rex Road Pump—80 g.p.m. at 500 lbs.—125 g.p.m. at 320 lbs.—enough water and fast enough for any paver, plus sprinkling, plus curing.



REX

SPEED PRIME

PUMPS

CONTRACTORS: Before you buy—or bid—INVESTIGATE the Rex '49ers—the 49 complete machines for the contractor made by

CHAIN BELT COMPANY MILWAUKEE WISCONSIN

Eastern Office: Room 529 Chrysler Building, New York City • *Main Office:* 1664 West Bruce Street, Milwaukee, Wis.
Western Office: 909 Harrison Street, San Francisco, Calif. • *Distributors in all principal cities*

CHAIN BELT COMPANY
1664 W. Bruce St.
Milwaukee, Wisconsin

Please send me the Catalog—"Rex Speed Prime Pumps."

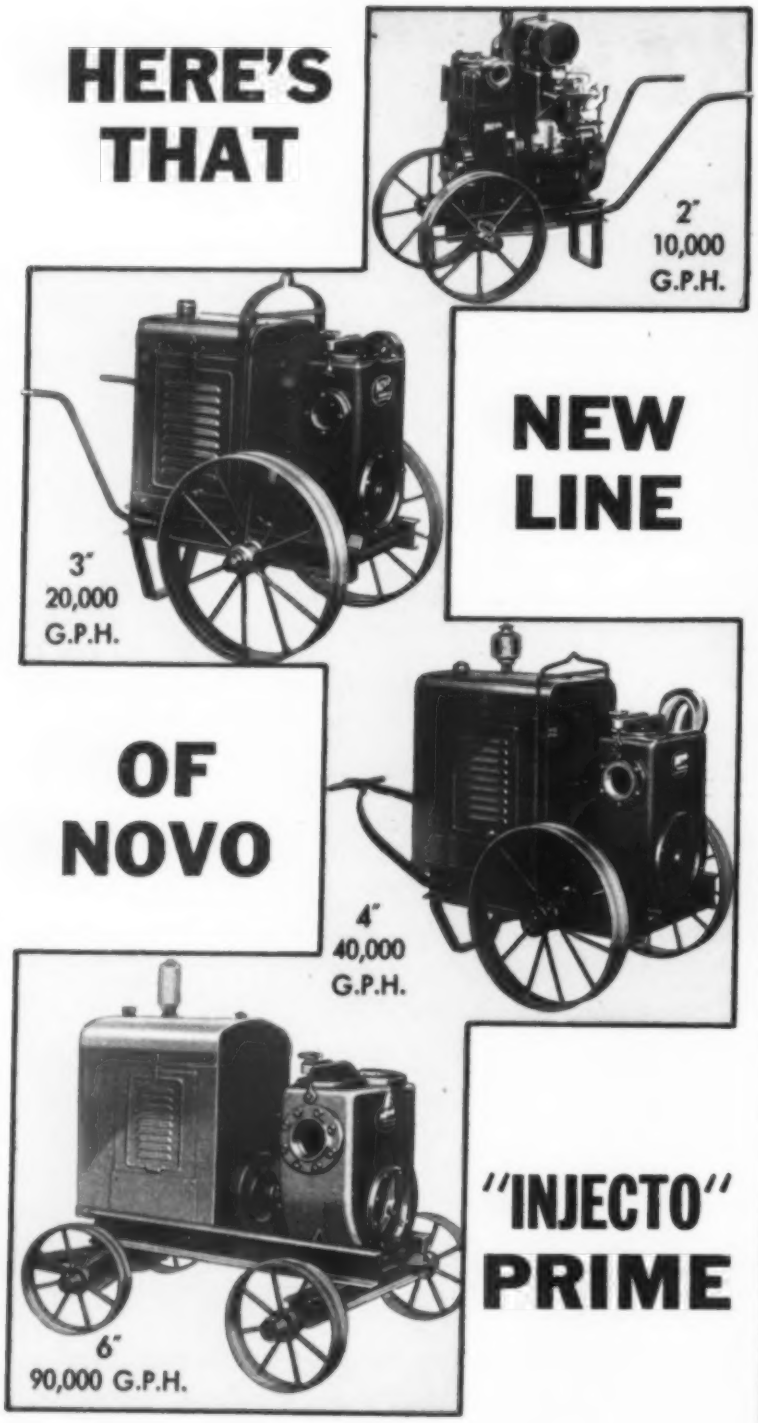
Name .....

Address .....

City .....

State .....

HERE'S THAT NEW LINE OF NOVO "INJECTO" PRIME



SELF-PRIMING CENTRIFUGAL PUMPS

First in Capacity

First in Priming

First choice of the wise contractor.

NOVO ENGINE COMPANY

214 Porter St., Lansing, Michigan, U. S. A.

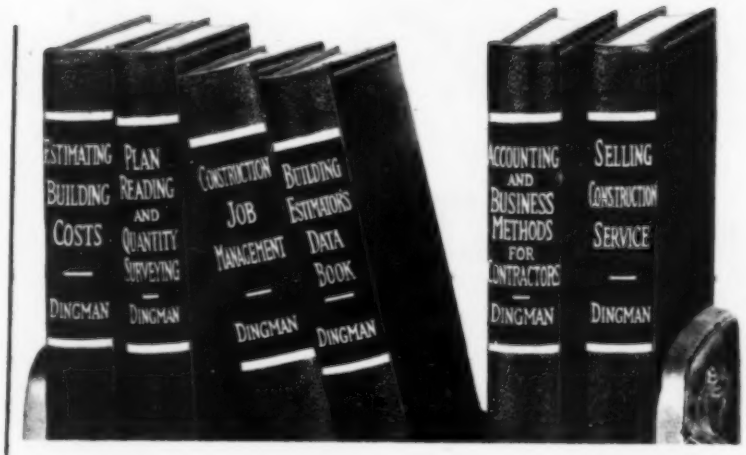
SEND THIS COUPON

Please send me Bulletin No. 164 describing and illustrating that New Line of NOVO (Injecto Prime) Self-Priming Centrifugal Pumps. This puts me under no obligation.

Name .....

Address .....

City & State .....



Practical facts on every phase of building construction!

HERE is a Library of books that are packed to the covers with the best plans and methods for speeding up production, saving materials and labor, and cutting costs. These six books cover every phase of practical construction work from estimating building costs to the selling of construction service—from plan reading and quantity surveying to practical job management. With the aid of these books the contractor can get business in these dull times by learning how to make savings, and through them being able to make lower bids. The construction superintendent can learn how to keep costs down, which insures his job these days.

The Dingman Building Contractors' Library

The Dingman books have won a wide reputation among builders and building contractors for their sound, practical and easy-to-understand discussion of building construction work. All of the material has been drawn from actual practice.

This library is intended for

[1] The building contractor who wants a handy reference set that will give him almost instantly a ready answer to most of the problems that come up in the course of the day's work.

[2] The young men in the building industry who intend to make the business of construction their life work, and who want the kind of guidance that will aid them to climb to the top.

[3] Everyone in the building industry who wants to keep his job by increasing his usefulness and efficiency.

Each one of the volumes in this set is a complete handbook on some important subject. Sturdily bound and pocket size, it will go right "on the job" with you for immediate consultation.

Practical data is given on analyzing a construction job into its component parts—estimating the costs of labor, haulage, equipment, materials, etc.—plan reading and determining quantities from specifications—personnel management—successful supervision of every building operation—efficient and economical business methods—office procedure such as accounting banking, purchasing, etc.—advertising and selling methods for contracting service—and a complete data book of tables, forms and calculations most frequently used by the builder.

Free Examination—Small monthly payments

Without a cent of expense—without any obligation on your part—you may examine the Dingman Building Contractors' Library for 10 days and determine its value for yourself. Try the books out on your everyday problems—make them prove their worth to you. Unless they meet every test send them back at our expense. If the books prove satisfactory and you decide to keep them, pay only $1.50 in ten days and then $2.00 a month for six months.

Every contractor and builder, every architect and engineer, every student and executive, who is seeking practical help on the everyday problems connected with building construction work should have this valuable reference library.

McGRAW-HILL FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc., 330 West 42d Street, New York, N. Y.

You may send me for 10 days' free examination, the new six-volume Dingman BUILDING CONTRACTORS' LIBRARY. I agree either to return the books at the end of 10 days or send a first payment of $1.50 then and $2.00 a month for six months.

Signed .....

Address .....

City and State .....

Official Position .....

Name of Company .....

(To insure prompt shipment, write plainly and fill in all lines.) C.M.-2-34

"VENTUBE" helps move the Colorado River to Los Angeles

In one of the greatest engineering undertakings of all time, part of the flow of the Colorado River is being carried to Los Angeles terminal, Cajalco Reservoir, 241 miles away.

Along the tortuous route of the aqueduct are mountains that are now being pierced by tunnels — 91 miles of them.

These borings are going through the bowels of the hills at record speed.

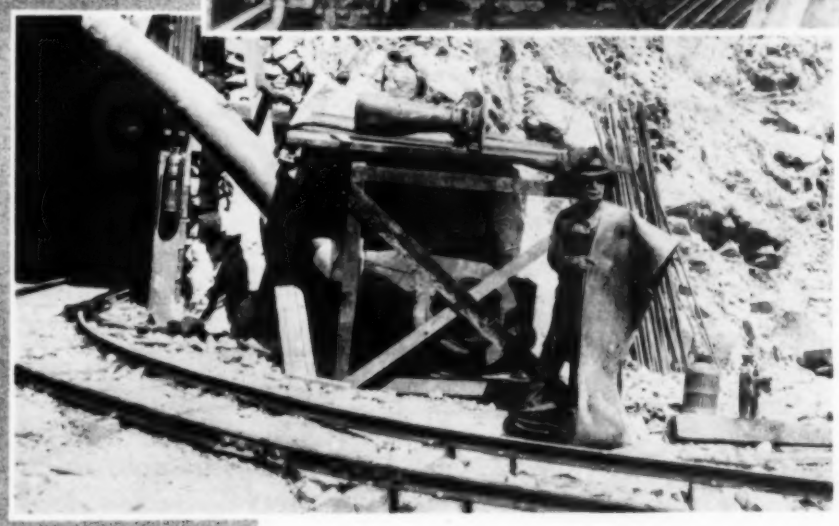
Du Pont Ventube, approved by mining and construction engineers the world over, is being used in a number of the aqueduct tunnels to carry fresh air to the working faces.

Write to us for information on the use of Ventube in all mining and construction work.

●

E. I. DU PONT DE NEMOURS & CO., INC.
FAIRFIELD CONNECTICUT

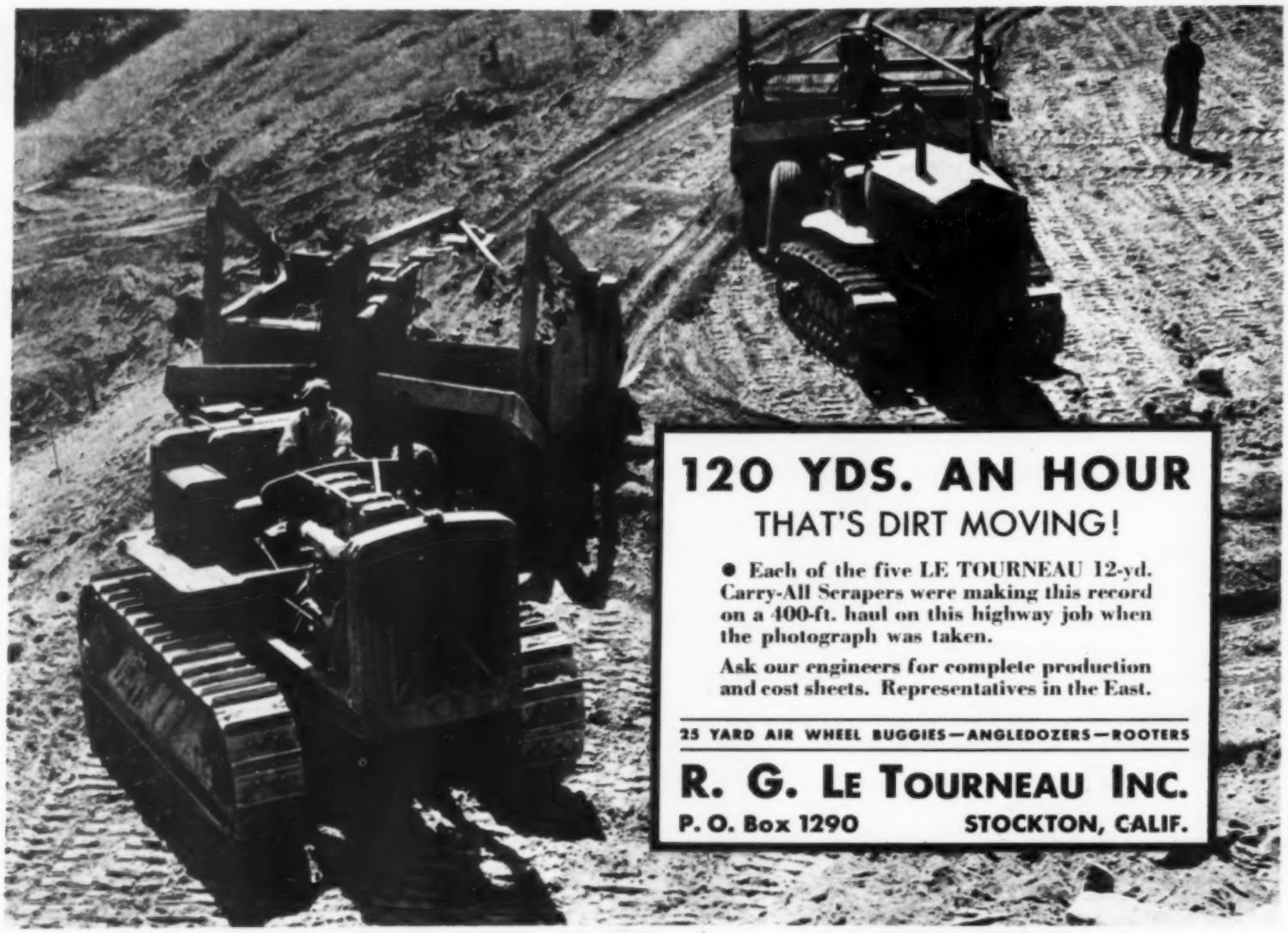
●



Upper right:—Ventube, portable, quickly assembled, delivers a constant flow of fresh air to such working faces as this.

Bottom:—Fargo Adit Coachell Tunnel on the Colorado River Aqueduct. On this first operation in the project, ventilation was with 12" du Pont Ventube.

DU PONT VENTUBE



120 YDS. AN HOUR

THAT'S DIRT MOVING!

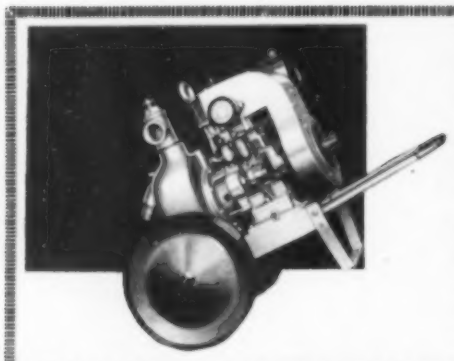
● Each of the five LE TOURNEAU 12-yd. Carry-All Scrapers were making this record on a 400-ft. haul on this highway job when the photograph was taken.

Ask our engineers for complete production and cost sheets. Representatives in the East.

25 YARD AIR WHEEL BUGGIES—ANGLEDOZERS—ROOTERS

R. G. LE TOURNEAU INC.

P. O. Box 1290 STOCKTON, CALIF.



Primes at over 25 ft. lifts—without hand adjustment.

No hand adjustment for recirculation cut-off.

Compact, rugged — one moving part.

3 times bigger water passages.

GIANT CAPACITY, FASTEST 100% AUTOMATIC PRIME with JAEGER 2", 3", 4", 6", 8", PUMPS!

Self-cleaning shell.

Timken or ball bearings.

No shaft packing.

Capacities 10,000 to 125,000 g.p.h.

Write for Prices!

The Jaeger Machine Co.

800 Dublin Avenue Columbus Ohio

LOWEST HANDLING COST with BAY CITY SHOVELS — CRANES — DRAGLINES

ONE YARD BAY CITY ON HEAVY-CUT, STATE HIGHWAY JOB

This Machine, with chain crowd, frictionless (New Departure) Bearings and Bay City modern design handled an average of 100 yards per day MORE than a competitive 1¼ yard machine on the same job and same working conditions.

Bay City Builds Sizes as Follows

⅜ yd. Tractor Shovel
⅜ yd. Heavy Duty Model 27
½ yd. Standard Model 30
½ yd. Heavy Duty Model K-2
¾ yd. Standard Model 42
¾ yd. Heavy Duty Model 52
1 yd. Special Model 52
1 yd. Heavy Duty Model 62
1¼ yd. Special Model 62

MODERN DESIGN
Honestly Advertised — Fairly Priced
— FOR 20 YEARS —
Builders of Dependable Shovels — Cranes — Dredges

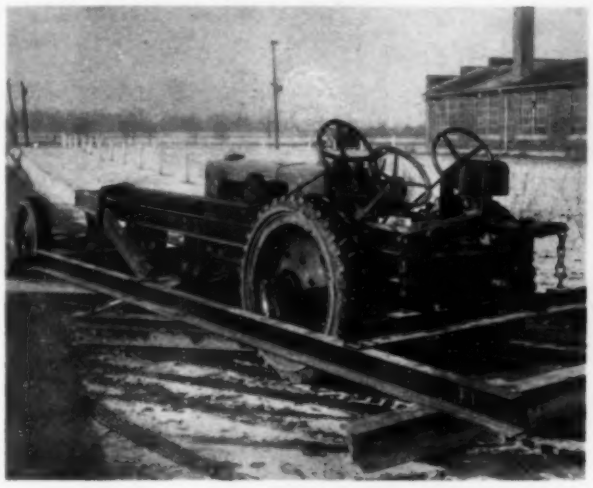
BAY CITY SHOVELS, Inc.

BAY CITY, MICH.

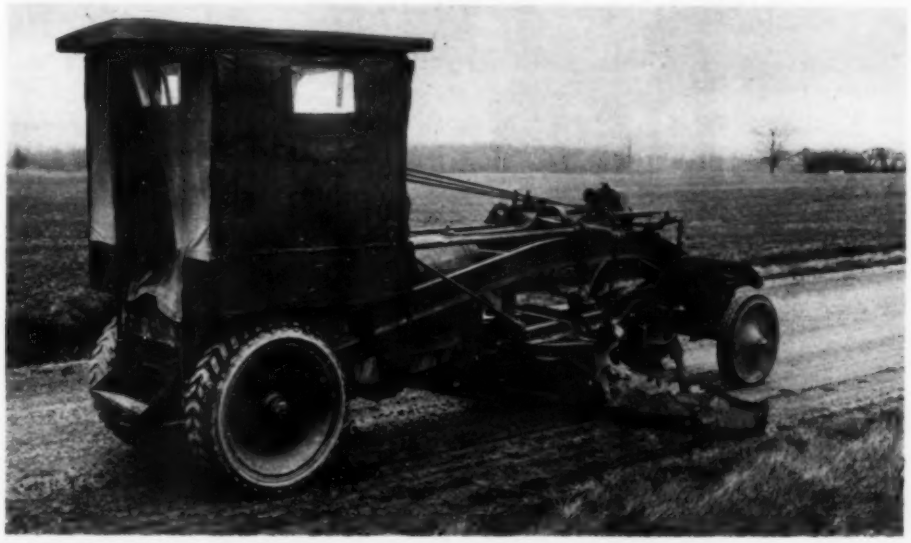
Member—Shovel, Dragline and Crane Institute

Road Machine Operating Costs Cut 20% to 30%! . .

● On graders, snow brooms, or any type of road maintenance machinery, Goodrich Z-P Pneumatics add 30% more traction, 30% more power.



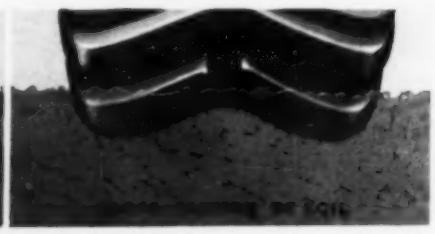
● More work in less time is reported for this maintainer operating on Z-P Pneumatics. From El Paso, Texas, comes a similar report: "In actual operation this grader with new Z-P Pneumatics has enabled the operator to increase his daily mileage from 8 to 10 miles over former tire equipment. A conservative estimate as to the increased performance would be at least 35% in addition to decreased maintenance expense."



● No air pressure is required for Goodrich Z-P (Zero Pressure) Pneumatics. They can't go flat! Deep cuts won't hurt the tire. Punctures, blow-outs and tire maintenance are crossed off the trouble list.

● "Since adopting Z-P Pneumatics we find that gasoline and oil consumption is reduced approximately 20% on our motor patrol graders," says prominent highway official.

● On soft ground or sand an air pressure tire digs in, tends to bury itself, requires more power to move the load. Efficiency is low.



● A Z-P Pneumatic pushes the soil under it, packs it down, actually forming its own track as it goes. No sinking. No spinning. Tread is self-cleaning.

Get Extra Service FREE

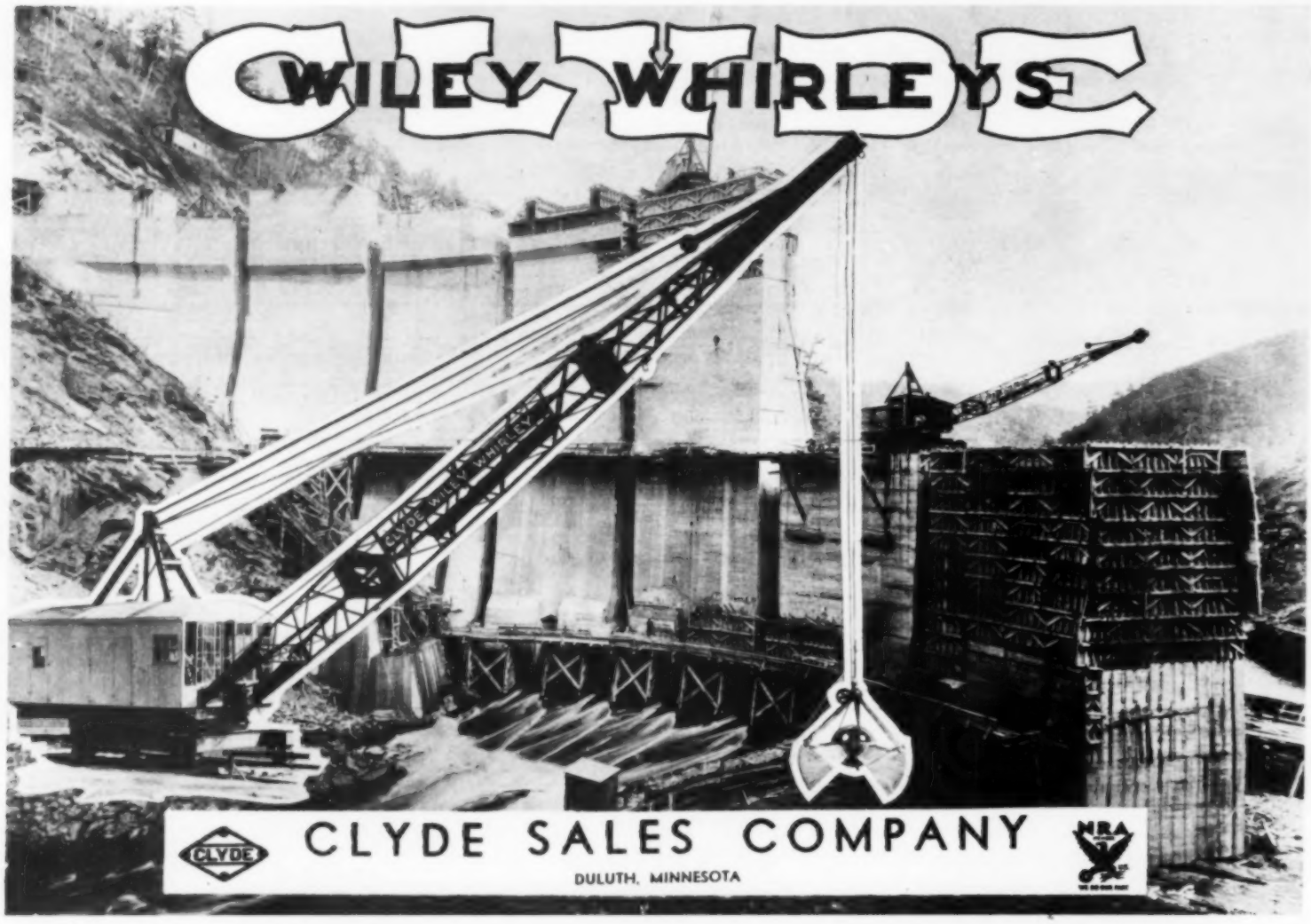
With the Goodrich Z-P (Zero Pressure) Pneumatic you get extra service which no other tire gives. Here is what this tire will do for you: give greater traction—eliminate punctures and blow-outs—stop bouncing—lower gas and oil costs—reduce tractor upkeep—speed up operations—outwear air pressure tires—cost less.

Write or wire today for complete information, prices. Address Dept. Z-50, The B. F. Goodrich Rubber Company, Akron, Ohio

Goodrich Z-P ZERO PRESSURE Pneumatic Tires

SPECIFY Z-P PNEUMATICS ON ALL YOUR NEW EQUIPMENT

CLYDE WILEY WHIRLEYS

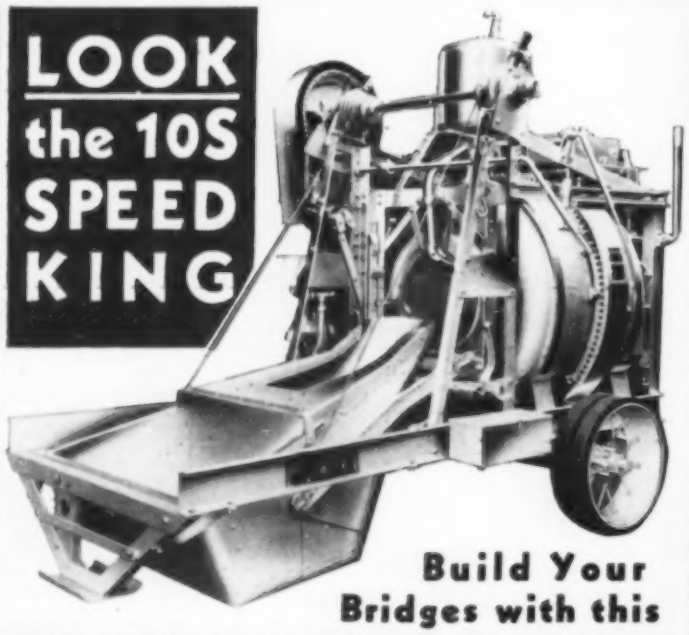


CLYDE SALES COMPANY

DULUTH, MINNESOTA

NRA

LOOK the 10S SPEED KING



Build Your Bridges with this

END DISCHARGE 2-BAGGER!

Also built with side discharge, 4 wheels

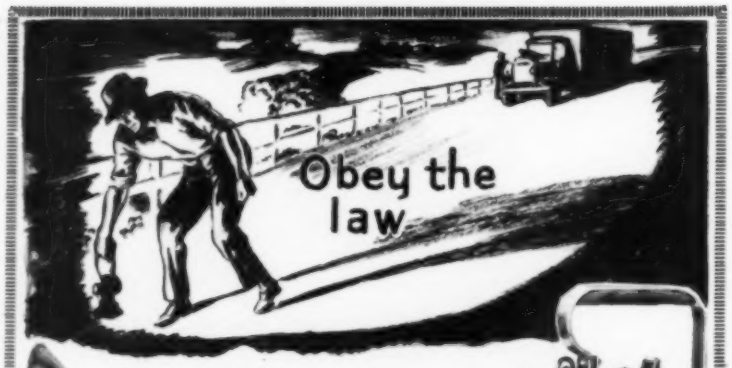
Full 2-bag capacity, plus END DISCHARGE, speeds up production and cuts your costs by discharging direct into bridge forms, pouring walks, floors, alleys with swinging spout, saving street space, saving wheelers.

Big brother to the famous Speed King 7S. Write for catalog, low prices.

THE JAEGER MACHINE CO.

800 Dublin Avenue Columbus, Ohio

GET OUR PRICES ON MIXERS, PUMPS AND HOISTS



with

NATIONAL CARBIDE LANTERNS

Lights a stalled truck and shows a red light to warn oncoming traffic

Place one of these Lanterns the required distance from the truck, on each side. Each lantern has *a red safety lens* in the rear. You get perfect two-way protection. This is only one example of the many kinds of service these sturdy, simple lanterns give. Lamp holds enough National Carbide and water for 8 hours continuous lighting.

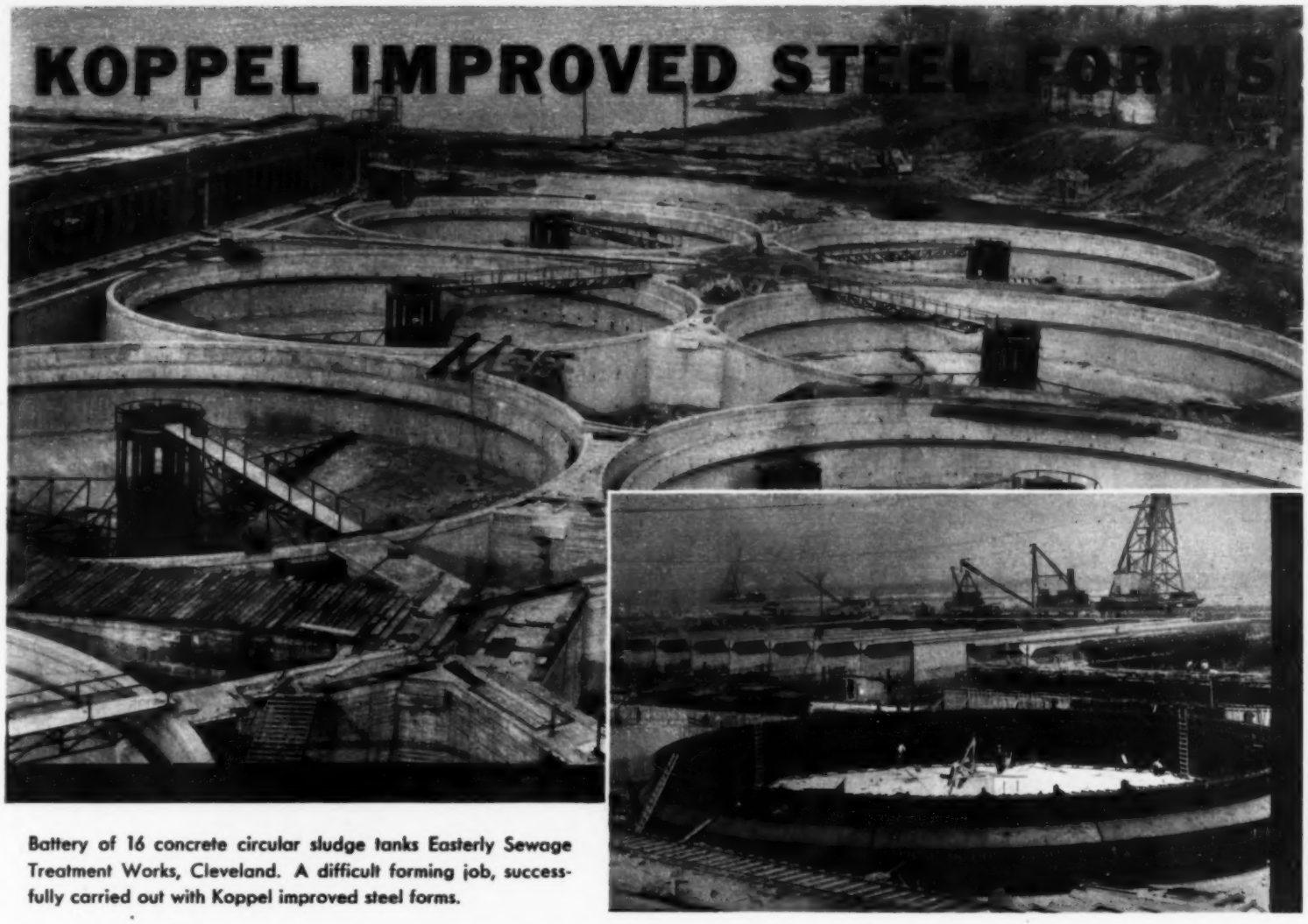
Other National Carbide Products:

National Carbide V-G Light 8000 cp.
National Carbide V-G Handy Light 1500 cp.
Manufacturers of National Carbide "In the Red Drum"

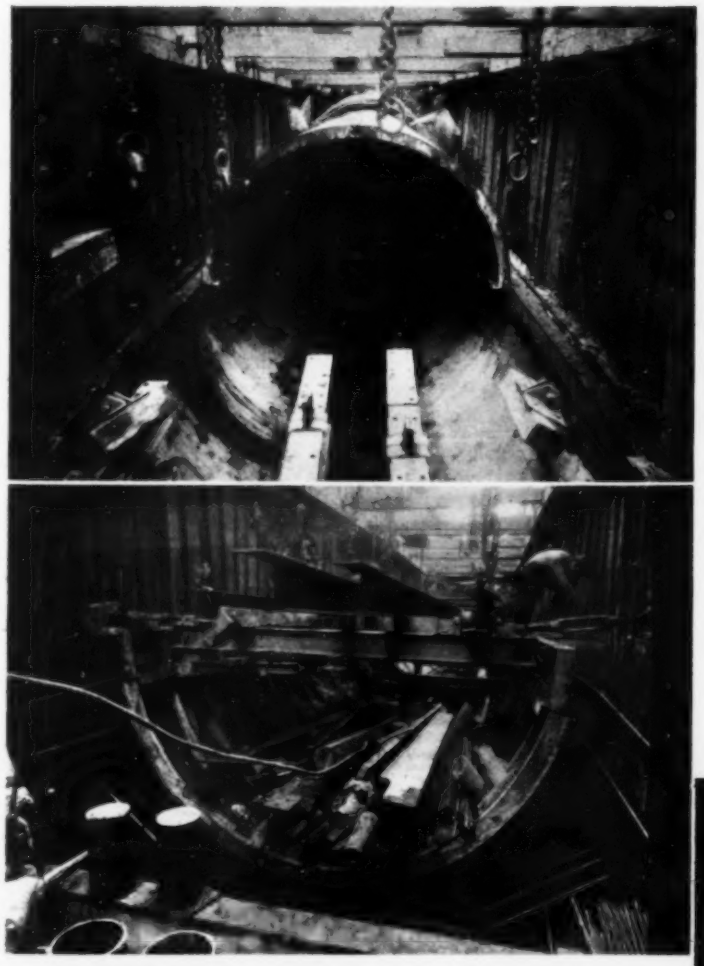
NATIONAL CARBIDE SALES CORP.

LINCOLN BLDG. NEW YORK, N. Y.

KOPPEL IMPROVED STEEL FORMS



Battery of 16 concrete circular sludge tanks Easterly Sewage Treatment Works, Cleveland. A difficult forming job, successfully carried out with Koppel improved steel forms.



Substantial savings resulted from using Koppel improved steel forms on this large trunk sewer project.

The successful contractor today, under highly competitive conditions, is a man who finds and adopts new and improved methods of carrying out construction projects.

Koppel improved steel forms for concrete construction have aided many contractors in reducing costs on important jobs. Our engineers are always ready and willing to cooperate.

Your inquiries will receive immediate attention.

▲ ▲ ▲

Koppel equipment also includes a complete line of cars, large and small, for every construction purpose.

TRADE MARK REGISTERED KOPPEL U. S. PATENT OFFICE

KOPPEL INDUSTRIAL CAR & EQUIPMENT CO.

General Office: **KOPPEL, PA.**

NEW YORK CHICAGO LOS ANGELES

What..

is business waiting for

Some few companies have never relaxed their sales and advertising efforts. Others have been prompt to get underway when the first faint signs of dawn began to break through the darkness of depression.

But all too many more are still hesitating, still waiting . . .

Waiting for what?

If business ever gets out of the darkness and into the light, it will be as it always has been, because courageous leaders get up and start at the break of day, while others wait for the sun to be fully up before they go out into the market place to display and sell their products.

It's not hard to learn who these courageous leaders are. You will find their names in the advertising pages of current McGraw-Hill business and industrial publications. Backed by sound advertising, their salesmen are abroad in the land. They are asking for orders . . . and getting them.

Is your business among these leading ones . . . or is it waiting . . . and if so, what for?

McGRAW-HILL PUBLISHING COMPANY, Inc.

330 West 42nd Street, New York City

NEW YORK • BOSTON • PHILADELPHIA • WASHINGTON • GREENVILLE • CLEVELAND
DETROIT • CHICAGO • ST. LOUIS • SAN FRANCISCO • LOS ANGELES • MONTREAL • LONDON

American Machinist
Aviation
Bus Transportation
Business Week
Chemical and Metallurgical Engineering
Coal Age
Construction Methods
Electrical Merchandising
Electrical West
Electrical World
Electronics
Engineering and Mining Journal
Engineering News-Record
Factory Management and Maintenance
Food Industries
Metal & Mineral Markets
Power
Product Engineering
Radio Retailing
Textile World
Transit Journal

REO GIVES YOU MORE TRUCK PER DOLLAR

With These 15 Superiorities Reo Challenges the Field for Low Cost Truck Performance

1-Highest Quality at Low Prices

2-Sturdy Frame

3-6 cyl. Gold Crown Engine—maximum torque at usable road speeds, instead of unusable horsepower available only at impractical road speeds.

4-Counterweighted Crankshaft

5-7 Main Bearings—Large Area

6-Full Pressure Lubrication

7-Full Floating, Steel Housing Axle

8-2 Speed Gasoline-Saving Axle Unit

9-Hydraulic Brakes

10-Large Brake Area

11-Long Springs

12-Cam and Lever Steering

13-Unusual Payload Capacity

14-Exceptional Loading Space, Properly Balanced

15-Advanced Selling Methods, Based on Ability Rating and Slide Rule

★

Illustrated—the 1½-2½ ton Reo Speedwagon

THE QUALITY TRUCK IN THE LOW PRICE FIELD

$595

1½-2½ TON CHASSIS
F. O. B. LANSING PLUS TAX
DUAL WHEELS EXTRA

REO has been in business long enough to know that a truck should be a truck—not a mere assembly of passenger car parts.

Check the present line of Reo Trucks and Speedwagons against anything in the market. You'll find Reo uses *Gold Crown* Engines—Engines that deliver ***real truck performance***. You'll find truck frames, truck axles, truck transmissions, truck tires, truck brakes.

Trucks all the way through—built of materials carefully selected for better wear and longer life.

Trucks that are rated for power in terms of ***torque*** at usable highway speeds—instead of unusable horsepower available only at impractical road speeds.

New low prices are now in effect—and Reo today actually gives you even more truck per dollar than ever before!

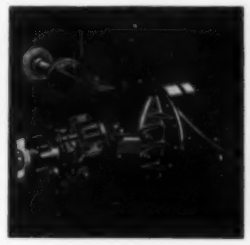
Never have Reo Trucks and Speedwagons been so perfectly balanced for exceptional service in ALL phases of hauling. There are not simply one or two outstanding features in a Reo—***fifteen major features*** that PROVE its all-round superiority!

Certainly it is unnecessary to pay more than the price of a Reo. And, in the opinion of many a shrewd buyer—unwise to pay less!

Reo Speedwagons and Trucks range from 1½ to 6 tons. Price range—$595-$2,595. 34 wheelbases. 6's-8's. Tractor-Trailer units from 15,000 to 32,000 pounds, gross. All prices chassis f. o. b. Lansing, plus tax.

WRITE today for illustrated booklet of comparative specifications and details of the 15 reasons why Reo challenges the field for low cost truck performance.

TRUCK BUYERS—ATTENTION!

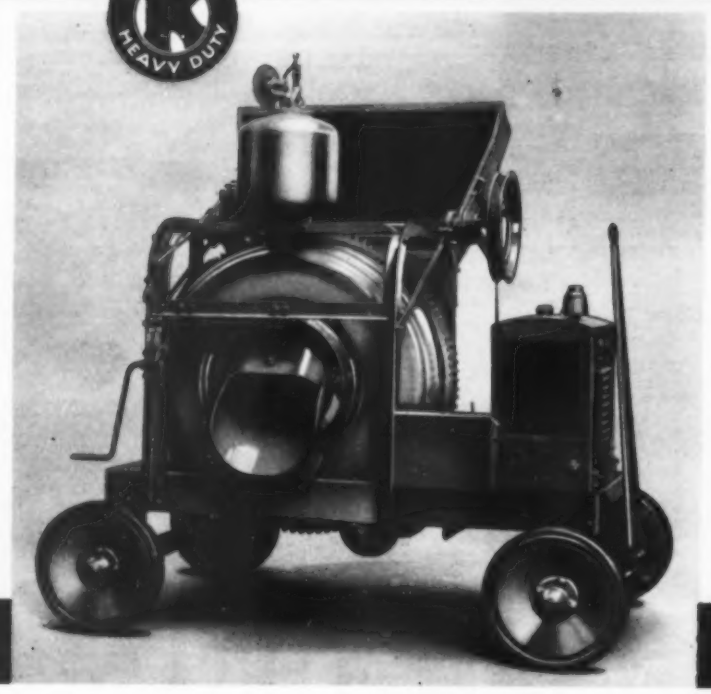


The new Reo built gasoline-saving two-speed rear axle unit gives you the equivalent of two motor sizes. Greater flexibility and economy for all types of work. Available at only slight extra cost.

The Reo Truck Performance Gauge gives the exact answer as to the truck best suited for your job. Before buying a truck, ask a Reo salesman to use this Gauge in determining your particular requirements.

REO MOTOR CAR COMPANY LANSING, MICHIGAN

KOEHRING
announces a NEW 10-S DANDIE



Weighing only 3800 lbs.

Full floating -- on springs

Exceptionally short wheelbase .. Accurate syphon-type tank .. Skip-shaker .. Anti-friction bearings .. Automotive type steering axle ... Multiple V belt drive

Write for bulletins illustrating
Koehring Construction Mixers—Kwik-Mix Tilting Mixers

KOEHRING COMPANY
Division of National Equipment Corporation
MILWAUKEE • • WISCONSIN

LIGHT • FAST • SHORT

KEEP POSTED

Next Month
CONSTRUCTION METHODS
brings you new ideas on:

—Placing Concrete in Boulder Dam

—"Helps to Successful Contracting"—By H. O. Locher

—Electrically Welded Steel Penstock Line

—Construction with C.W.A. Forces

—and other new trends in construction practice

It Will Pay You to Have a Personal Copy Each Month

Think of the satisfaction—the convenience—of having your personal copy of Construction Methods sent direct to your home. You can sit down and read it from cover to cover while the ideas it brings you are new, *you need not wait to be seventh on the list* and then find pages missing. Get your own copy. Then after reading it, if you want to clip certain photographs, you can do so without penalizing some other person. In this way you can build up a valuable reference file that you can use on the job.

Don't continue to be just "one on the list," enter a personal subscription by attaching a $1 bill to the coupon and mail it today.

CONSTRUCTION METHODS
330 West 42d Street
New York City, N. Y.

Here's my dollar!
Send me the next 12 big issues of CONSTRUCTION METHODS.

NAME .....
ADDRESS .....
CITY .....STATE.....
EMPLOYED BY .....

SEND THE COUPON

***NON-PREFORMED WIRE ROPE** dissipates its strength because wires and strands are held in place by FORCE*

Dissipated Energy!

● Ordinary wire rope doesn't *go* "wild" . . . when seizing is removed.

It's been "wild" from *end to end* since the day it was made . . . constantly dissipating energy . . . with its wires and strands FORCIBLY held in position in the rope structure.

Non-preformed wire rope can never RELAX. It is born with "high blood pressure" . . . with "heart strain" . . . with the organic disease known as INTERNAL STRESS. It goes to the job handicapped—to break down long before its time.

That's why wire rope replacement costs often reach staggering totals on many jobs . . . dissipated expense which could be saved.

Nearly ten years ago the American Cable Company gave wire rope its first "sound heart" by manufacturing it to eliminate this *unnecessary* INTERNAL STRESS. Wires and strands were preformed to lie together, naturally, within the body of the rope, giving industry the first completely RELAXED wire rope. Since then TRU-LAY Preformed Wire Rope, organically sound, has proven its value on thousands of jobs wherever wire rope is used. Dissipated energy has been changed to *directed* energy.

Not only have the destructive effects of internal stress been removed, but preforming has contributed other remarkable advantages. TRU-LAY Preformed Wire Rope provides equal strand balance, equal distribution of working stresses and, consequently, uniform wear. It is easier to handle and to splice, resists kinking and high stranding, and can be cut without seizing.

Replace with TRU-LAY Preformed Wire Rope and cut maintenance and operating costs. Made in all standard sizes, constructions and lays. Write today to

AMERICAN CABLE COMPANY, Inc.
WILKES-BARRE, PENNSYLVANIA
An Associate Company of the American Chain Company, Inc.
District Offices: Chicago, Denver, Detroit, New York, Philadelphia, Pittsburgh, Houston, San Francisco

for HAULING · DUMPING · SPREADING
« SAVING SECONDS AT THE DUMP »

Every second counts on any dirt moving job .. The Koehring Wheel Dumptor travels to the end of the grade and the load is dumped and bulldozed ... no backing, turning, jockeying .. many seconds gained. Instantaneous gravity dump saves more seconds ... kick-out pan insures clean dump.

KOEHRING COMPANY
Division of National Equipment Corporation
MILWAUKEE • • • WISCONSIN

The KOEHRING WHEEL DUMPTOR

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or RESALE

UNDISPLAYED—RATE PER WORD
Positions Wanted (full or part-time salaried employment only), 5 cents a word, minimum $1.00 an insertion, payable in advance.
(Sec. ₡ on Box Numbers.)
Positions Vacant and all other classifications 10 cents a word, minimum charge $2.00.
Proposals, 40 cents a line an insertion.

INFORMATION:
Box Numbers in care of New York, Chicago, and San Francisco offices count 10 words additional in undisplayed ads.
Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH:
1 inch $6.00
2 to 3 inches ..... 5.75 an inch
4 to 7 inches ..... 5.50 an inch
Other spaces and contract rates on request.
An advertising inch is measured vertically on one column, 3 columns—36 inches—to a page.

COPY FOR NEW ADVERTISEMENTS RECEIVED UNTIL MAR. 2ND FOR THE MARCH ISSUE

● HYDRAUGER ●
MODERN HORIZONTAL BORING MACHINE
For Underground Installation of Pipe and Conduits. Avoids damage to costly pavements and saves time. Send for Bulletin.
HYDRAUGER CORPORATION, LTD.
343 Sansome Street • San Francisco, California

For Sale at a Bargain
1—Model No. 60, 1929 Caterpillar Tractor equipped with Highway Winch and Towing Device.
1—Model No. 60, 1931 Caterpillar Tractor equipped with a Highster Winch and Towing Device.
1—20-gal. Hilliard Oil Reclaimer.
Both of these tractors are in perfect condition, having only been used on two small jobs.
FS 108 CONSTRUCTION METHODS
330 West 42nd St., New York City

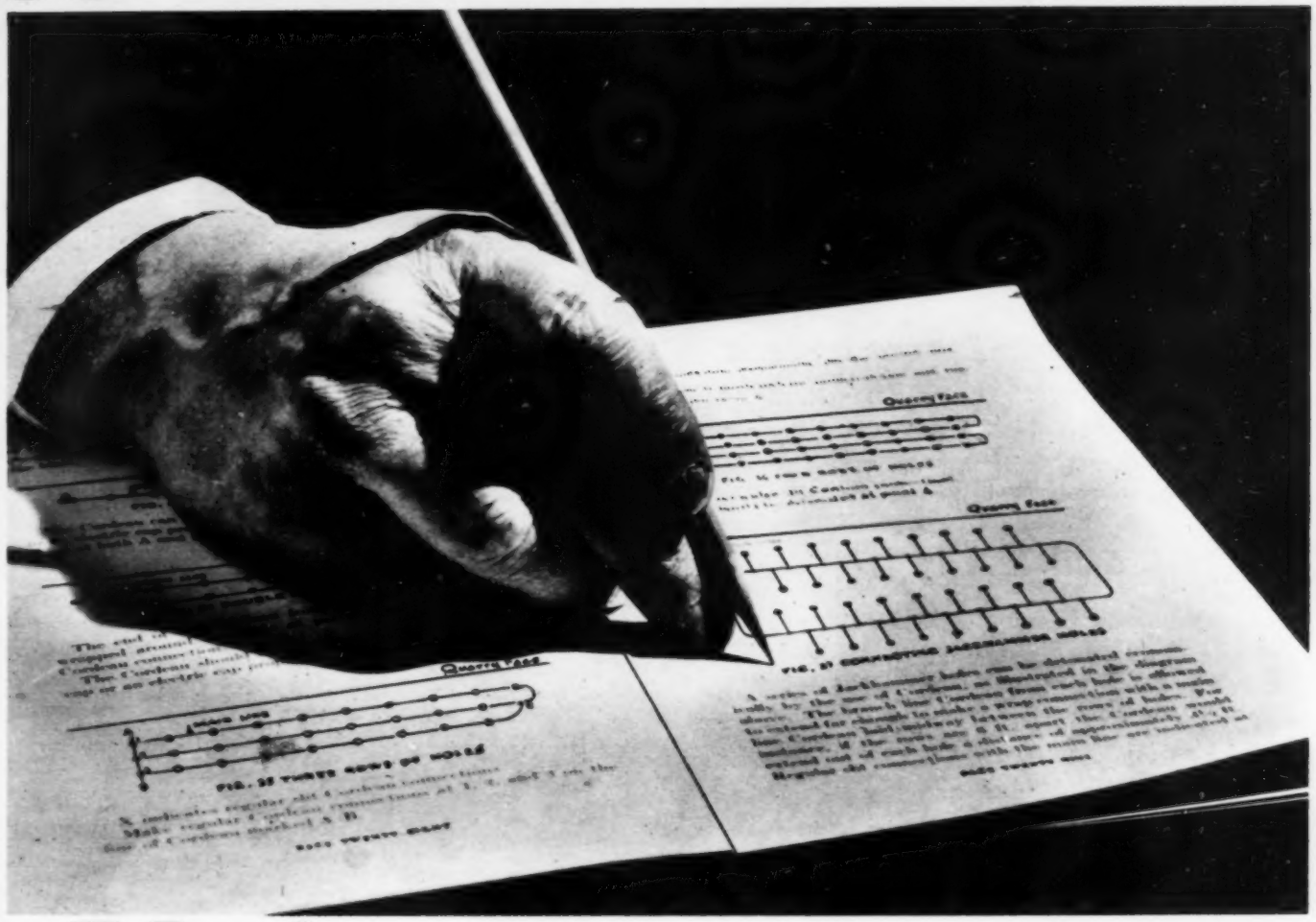
SPECIAL SERVICE

SOVIET RUSSIA
I worked there 1932, 1933. Will advise on engineering, business, and general conditions. Reasonable charges. SS109 Construction Methods, 330 West 42nd St., N. Y. C.

ALPHABETICAL INDEX TO ADVERTISERS

This index is published as a convenience to the reader. Every care is taken to make it accurate, but *Construction Methods* assumes no responsibility for errors or omissions.

American Cable Co. 59
American Hoist & Derrick Co. 15
Atlas Powder Company 12
Austin-Western Road Mchy. Co. ..... 4th Cover
Barber-Greene Co. ..... 2nd Cover
Barrett Company 8
Bay City Shovels, Inc. 52
Blaw-Knox Company 30-31
Bucyrus-Erie Co. 7
Caterpillar Tractor Co. 48
Chain Belt Co. 49
Cleveland Tractor Co. 14
Clyde Iron Wks. 54
Du Pont de Nemours Co., Inc., E.I. 51
Ensign-Bickford Co. ..... 3rd Cover
Euclid Road Mchry. Co. 3
Firestone Tire & Rubber Co. 5
Goodrich Co., B. F. 53
Hazard Wire Rope Co. 4
Harnischfeger Corp. 9
Jaeger Machine Co. 52-54
Koehring Company 58-60
Koppel Industrial Car & Equip. Co. 55
Le Tourneau, R. G. 52
Link-Belt Company 6
Lincoln Electric Co. 56
McGraw-Hill Book Co. 50
National Carbide Sales Corp. 54
Novo Engine Company 50
Ohio Power Shovel Co. 47
Reo Motor Car Co. 57
Roebling's Sons & Co., J. A. 13
Searchlight Section 60
United States Pipe & Foundry Co. 10-11
Universal Atlas Cement Co. 16

SEARCHLIGHT SECTION
Classified Advertising
Hydrauger Corp., Ltd. 60

Yes! *it can be profitable to hook up jackhammer holes with* Cordeau-

Pass one end of the Cordeau-Bickford Detonating Fuse through a cartridge and drop to the bottom of the hole. Load and tamp. Connect each hole as shown by making wrap connections with the main lines of Cordeau, laid midway between the rows of holes. Cap the end of the main line with an EB Cap or Fuse Cap—and fire all the holes at one time. There is no limit to the number of holes that can be connected at one time.

Each load will have added force because every cartridge will be in contact with the detonating agent. This means more work from your explosives, better blasting. And the fact that Cordeau is an *insensitive* detonator, brings other important advantages.

There is a new technique in blasting, which brings new economies to operators everywhere. It is explained and illustrated in the Cordeau Book —free to executives.

CORDEAU
DETONATING FUSE
BICKFORD

SAFETY FUSE
and
LIGHTERS

Ensign-Bickford Safety Fuse is available in a number of standardized brands, each carefully made for a particular set of conditions. The use of Safety Fuse simplifies blasting technique.

Also—there are a number of Ensign-Bickford lighters, inexpensive—and positive in action.

CB26

The Ensign-Bickford Company — Simsbury, Conn.

FOR ROAD WORK AT ITS TOUGHEST...

SPECIALIZED 10 FEATURES

1 *Strength* of box girder construction minimizes possible damage from hitting boulders and stumps.

2 *Flexibility* of front trucks permits one front wheel to be raised far above the other without tilting the frame.

3 *Maneuverability* for ready turning on rough ground and in small area.

4 *Visibility* to an unequaled degree made possible by one-piece welded frame design.

5 *Maximum Capacity* blade held to its work by heavy oversize steel circle.

6 *High Lift Position* for blade (greater than 70° from horizontal) Adjustments made easily and quickly.

7 *Leaning Wheels* keep the blade against the bank, and are proof against locking, blocking or jumping.

8 *Wide Spacing* of frame bearing supports, at rear axle, resists distortion or rail springing.

9 *Maximum Safety* for the operator by absence of controls behind or at side of platform.

10 *Operating Ease* through double-supported ball-and-socket joints and enclosed worms operating in grease—facilitating quick adjustments.

● Convincing as any showroom demonstration may be after all, it is on the job that equipment must prove itself. It is on the job—countless jobs!—that the Austin Blade Graders won their reputation. On at least ten counts these road machines are specially adapted to twisting impacts and severe shocks which no other graders would be expected to survive. Put up against the toughest kind of going, miles from easy repair facilities, they are the machines you can count on to "come through". Send the coupon below for fully illustrated bulletin and specifications.

NRA MEMBER U.S. WE DO OUR PART

The Austin-Western Road Machinery Co.
400 No. Michigan Ave.,
Chicago, Ill.

The Austin-Western Road Machinery Co.
400 N. Michigan Ave., AG Chicago, Illinois
Please send details on No. 8☐, 10☐, 11☐, 12☐, Graders-
Name ..... State .....
Address .....
City .....

Austin-Western

ROAD ROLLERS, CRUSHING & SCREENING PLANTS, SCARIFIERS, SWEEPERS & SPRINKLERS, ROAD GRADERS, ELEVATING GRADERS, MOTOR GRADERS, DRAGS, SHOVELS, TRENCHING MACHINES, CONTINUOUS DISTRIBUTORS, WAGONS, SNOW PLOWS.